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NOTICE OF THE ROCKS
LYING BETWEEN THE
CARBONIFEROUS LIMESTONES
OF THE
LOWER PENINSULA OF MICHIGAN
AND THE
LIMESTONES OF THE HAMILTON GROUP:
WITH DESCRIPTIONS OF SOME
CEPHALOPODS
SUPPOSED TO BE NEW TO SCIENCE.

Smithsonian Institution
National Museum.

BY

ALEXANDER WINCHELL,
STATE GEOLOGIST OF MICHIGAN.

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ON THE ROCKS LYING BETWEEN THE CARBONIFEROUS LIMESTONE OF THE LOWER PENINSULA OF MICHIGAN, &c.

Throughout the counties of Hillsdale and Calhoun, and the southern half of Jackson county, in the Lower Peninsula of Michigan, occur frequent outcrops of a fine, friable ferruginous sandstone whose stratigraphical position in this part of the state, is not more than forty or fifty feet below the Carboniferous limestone. The whole thickness of the series is less than 300 feet. The upper portion of this succession of sandstone strata is more grayish than the lower, more firmly cemented, and more homogeneous; and it has thus far proved remarkably destitute of organic remains. The lower portion of the series, which is separated from the upper by fifteen feet or more of shale, is of a dingy-reddish or yellowish color, with a very conspicuous amount of ferruginous matter, often disposed in bands conformable with the lamination of the rock, or producing a rude concretionary structure, and not unfrequently solid nodules and bands of ironstone. At Battle Creek in Calhoun county, these strata, when not weathered, are of a bluish color, and firmly cemented by an abundance of calcareous matter. At Hillsdale and Jonesville in Hillsdale county, these sandstones are thicker-bedded, more fine and homogeneous, and incline more to an olive color. The lowest strata here are bluish, shaly and highly micaceous. The most instructive exposures of this part of the sandstone series occur at Hillsdale, Moscow and Jonesville in Hillsdale county, and at Marshall, Ceresco and Battle Creek in Calhoun county. At most of these localities, especially those in Calhoun county, the sandstone is well stocked with fossil remains belonging to the genera *Goniatites*, *Nautilus*, *Orthoceras*, *Bellerophon*, *Nucula*, *Solen*, *Myalina*, *Chonetes*, &c. These lower fossiliferous sandstones have been designated the "Marshall Group," and the upper, unfossiliferous beds the "Napoleon Group," though it will appear obvious there are no very conclusive reasons for separating the two groups.

From this part of the state, the outcrops of these two groups are believed to trend northeast and northwest in curved belts toward Pt. aux Barques and the mouth of Grand river. Toward the northwest, the next actual exposure known is in the township of Holland, Ottawa county, and west of there to the vicinity of Lake Michigan; though the intervening space affords numerous loose fragments of the formation. The Napoleon sandstone is seen again near Grandville in Kent county, and the Marshall sandstone near the center of Ottawa county. Toward the northeast, the next actual exposure occurs near the sources of the Cass river in Sanilac county, whence the sandstones are traceable to the shore of Lake Huron, which they occupy from the mouth of Pigeon river to Pt. aux Barques.

The fine-grained sandstones of the southern part of the state are overlaid by the saliferous and gypsiferous clays of the "Michigan Salt Group," attaining a thickness of 184 feet at Grand Rapids and Saginaw, but in Jackson county attenuated to less than 50 feet. They are underlaid in Branch, Calhoun, St. Joseph and Van Buren counties, by a considerable thickness of argillaceous strata sometimes plastic and abounding in Kidney iron ore, sometimes shaly, and sometimes blackened with bituminous matter. They contain very few fossils.

In the vicinity of Pt. aux Barques, the typical Marshall sandstone is separated by two feet of conglomerate from the bluish, fine-grained, homogeneous gritstone, from which have been manufactured the famous Huron grindstones. These are succeeded downwards by a great thickness of dark, fissile, somewhat bituminous shales, with intercalated flagstones, striking nearly southward in lines parallel with the lake shore in Huron and Sanilac counties, and occupying, as is believed, a large portion of the bed of the lake between Saginaw Bay and Port Huron. At a lower level occur the black bituminous shales of Kettle Pt. on the Canadian shore, and Sulphur island and Squaw Pt. at the head of Thunder Bay on the Michigan shore. At the latter localities, these are succeeded by the fossiliferous limestones of the Hamilton group. The black shales are seen again near the mouth of Grand Traverse Bay, covered by a few feet of green shale, and underlaid as before by the Hamilton limestones. No rocks of the age of the Hamilton Group have been recognized as yet, in the southern part of the state.

The following is a synoptical view of the strata embraced in the foregoing sketch; aggregate thickness over 800 feet.

Carboniferous limestone,		66	feet.
Michigan Salt Group,		184	“
Napoleon Group,		123	“
(*d*) Shaly micaceous sandstone,	15		“
(*c*) Napoleon sandstone,—highly saliferous in many localities,	78		“
(*b*) Shaly, micaceous sandstone,	15		“
(*a*) Clay and shale, more than	15		“
Marshall Group,		173	“
(*d*) Reddish, yellowish and greenish sandstones,	147		“
(*c*) Shaly, micaceous sandstone,	10		“
(*b*) Conglomerate,	2		“
(*a*) Fine, bluish gritstones,	14		“

Huron Group,		210	feet.
(*c*) Shales, limestones and flagstones,	180		"
(*b*) Green shale,	10		"
(*a*) Black bituminous shales,	20		"
Hamilton Group,		55	"

The reëxamination of the ferruginous sandstones and underlying shales, which have been made within the last two or three years, have tended to confirm the opinion long entertained that they are the equivalents of certain formations in other northwestern states whose true geological horizon has not yet been settled by the general consent of American geologists. The interest which attaches to any definite information bearing upon the controverted question of the exact age and equivalents of these rocks, would seem to justify the attempt to make known the facts in my possession. I accordingly submit the following notice of some characteristic fossils occurring in the rocks under consideration:

DESCRIPTION OF CEPHALOPODS FROM THE MARSHALL AND HURON GROUPS OF MICHIGAN.

ORTHOCERAS INDIANENSE.

O. Indianensis Hall, 13th Rep. N. Y. Regents, p. 107.

Septate portion of shell more than 3·75 inches* in length; inclination of sides forming an apical angle which varies in different specimens from 6° to 11°; transverse section circular; septa at right angles with the central siphon; ratio of depth of chamber to its diameter, in different specimens 2·0, 2·67, 2·71 and 3·46; ratio of concavity of septum to its diameter 2·81; ratio of diameter of siphon to diameter of shell 5·67. No surface markings discernable on the cast.

Localities. The most abundant *Orthoceras* in the Marshall sandstone. I have specimens from Marshall, Calhoun county, Holland, Ottawa county, Moscow and various other points in Hillsdade county, and from Hard Wood Pt. (one mile S.W. of Pt. au Pain Sucre) on the shore of Saginaw Bay in Huron county.

The specimens from Michigan exhibit all the characters published, of *O. Indianensis* Hall, except the apertural constriction, with reference to which I have not been enabled to make any observations. The casts of this species cannot be distinguished from those of *O. cinctum* Sowerby, as defined by de Koninck ("Animaux Fossiles," p. 513, pl. xliii, fig. 6; xliv, 5; xlviii, 3). It is equally undistinguishable from *O. Goldfussanum* de Kon. (op. cit., 510; pl. xliii, 3, 4), except that the septa of this species are separated by only about one-eighth of their diameter.

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* The measurements in the following descriptions are all given in inches. Where a measurement is followed by a number in parentheses, the latter is the *relative* dimension, the greatest measure given in the description being assumed as 100.

ORTHOCERAS ROBUSTUM, n. sp.

A septate fragment of this species has such a curvature that the individual must have been 3·4 in diameter. Amongst other fragments of the last chamber of the shell, one is so large as to imply a diameter of 4·6. The septa appear to be transverse, separated from each other ·31, where the diameter is 3·4, giving a ratio of 11. In another specimen this ratio is ·15 : ·98=6·54. No surface markings are indicated upon the casts. Siphon not seen.

Localities. Marshall, Moscow and Hanover in Jackson county.

This species has the size and general appearance of *O. giganteum* Sow. (de Kon., op. cit., 510, pl. xliv, 2; xlv, 3; xlvi, *a*, *b*; xlvii, 1), but differs, as far as observed, in having the septa separated by one-sixth to one-eleventh of their diameter, instead of one-third. It differs from *O. crassum* F. Röm. (Sandberger, "Versteinerungen," p. 164, Taf. xix, fig. 1) by a much greater approximation of septa; and this reason, as well as its very great size, has induced me to separate it from *O. Indianense.*

ORTHOCERAS VITTATUM. ?
Sandberger (Verstein., 165; Taf. xx, 9).

Shell very gradually tapering; transverse section circular; ratio of the depth of the chambers to their diameter ·09 : ·22= 2·56; ratio of concavity of septa to their diameter ·07 : ·22=3·14. Siphon apparently slightly excentric. Surface (of cast) marked by delicate encircling bands, separated by rather sharp, fine grooves; four of these bands correspond to each chamber. There are also very feeble indications of striæ covering the bands.

Locality. In the Marshall sandstone at Battle Creek or Holland.

The single specimen in my possession differs from Sandberger's description only in the words "taeniis transversalibus *paullo obliquis.*" It differs from *O. bicingulatum* Sandberger (Verstein., 162, Taf. xvii, 3) in the transverse direction of the rings, and the perfectly circular section.

ORTHOCERAS ARCUATELLUM. ?
Sandb. (Verstein, 166; Taf. xix, 2).

Shell tapering to an angle of 12°; nearly smooth externally, with faint, encircling, unequal, irregularly sinuous striæ; section circular; septa transverse, with a convexity equal to one-sixth or one-seventh their diameter; siphon central. (?)

Locality. In the Marshall sandstone at Marshall.

The general characters of this shell present a good agreement with the species to which I have doubtfully referred it; but it is easy to point out differences. Our shell has a much less rapid taper, and the encircling striæ are much finer, more unequal, and not regularly reflexed on the anterior and posterior sides; moreover, no observations have yet been made on the depth of the chambers, while the position of the siphon admits of some doubt.

ORTHOCERAS OCCIDENTALE, n. sp.

Septate portion of shell more than 3¾ inches in length; greatest apical angle 8° to 12°; transverse section an ellipse whose minor axis is to the major as ·37 : ·48=1·3; septa nearly transverse with a concavity equal to about one-fifth the greater diameter; interseptal space about one-fourth the same diameter. Siphon situated on the minor axis about midway between the center and periphery, constricted where it passes through the septa, about ·06 in diameter in the chamber and ·04 in the constriction.

Not O. occidentale [illegible]

Localities. In the Marshall sandstone at Marshall and Moscow.

This species differs from *O. Muensterianum* de Kon. (An. Foss., pl. xlviii, 1, 5), by its nearly transverse instead of very oblique septa.

ORTHOCERAS BARQUIANUM, n. sp.

Septate portion of shell more than 4¼ inches long; greater apical angle (i. e., the one formed by the sides which are not compressed) about 10°; transverse section an ellipse whose minor axis is to the greater as ·35 : ·50=1·43; septa somewhat oblique, making an angle of 8° or 10° with a transverse plane, most elevated near one extremity of the longer diameter; amount of concavity and position of siphon unknown; distance between the septa about one-fifth the greater axis at the same place. No surface markings evident from an examination of casts.

Locality. Near the light house at Pt. aux Barques in a hard bluish sandstone embraced in the shales of the Huron Group. (See Huron Group, (*c.*) of the preceding table.)

This species may possibly prove identical with the preceding, but its apical angle is somewhat less, its septa more oblique, its section more excentric, and its geological position considerably lower.

ORTHOCERAS MARSHALLENSE, n. sp.

Septate portion of shell more than 5·75 inches long; greater apical angle 6°; transverse section an ellipse whose axes are to each other as ·36 : ·61=1·69; ratio of interseptum to greater axis ·25 : ·45=1·8; septa very concave, the concavity equaling ·17; siphon on the minor axis, a little excentric. The cast gives no evidence of surface markings.

Locality. In the Marshall sandstone at Marshall.

This species is readily distinguished from its allies and associates by the great distance of the septa from each other, and the very gradual taper of the shell.

ORTHOCERAS CLINOCAMERATUM, n. sp.

The only specimen of this quite distinct form is only 1½ inches in length, partly septate. It is a fragment of a shell about 3·3 inches long, having a major apical angle of 11°. The section is elliptical, with the minor axis to the major as ·24 : ·45=1·88. The first two septa are ·08 apart, and the ratio of this interval to the larger diameter at the same point is 6·25. The septa are deeply concave, oblique, and slightly sinuous, having one side ·12 in advance of the other. The greater diameter of the specimen is ·7 at one end and ·45 at the other.

Locality. In the Marshall sandstone at Hard Wood Pt. one mile S.W. of Pt. au Pain Sucre (called also Flat Rock Pt.) on the shore of Saginaw Bay.

ORTHOCERAS RETICULATUM.?

Phillips (Geology of Yorkshire, vol. ii, p. 238; pl. xxi, fig. 11).

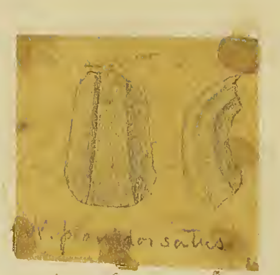
The brief description given of this Carboniferous species does not disagree with the Michigan specimen in my possession. The figure agrees equally well. The fragment in question is 1¼ inches long, and shows only the exterior markings. Judging from the curvature of the specimen, it had a diameter of ·89 in the constriction between two rings, which are ·32 apart. The surface is marked by longitudinal and transverse striæ; the former are fine, raised, equidistant, 13 or 14 being embraced in the space of one-tenth of an inch; the latter consist of two sets —first, a set of irregular inequidistant, impressed striæ of which 3—6 occur in the space of one-tenth of an inch; secondly, a set of fine, regular, equidistant, filiform striæ, of which about 32 occur in the space of one-tenth of an inch. The latter give a finely moniliform appearance to the longitudinal striæ, but they are most distinctly seen after the exterior of the shell has been removed. Characters of the siphon and septa unknown.

Locality. In the Marshall sandstone at Marshall.

ORTHOCERAS sp.?

The only specimen seen of this species is a mere impression of the exterior, about an inch in length. It is made by a shell, apparently, with a circular section, and ornamented by a series of rounded rings, separated from each other by a concave depression about twice the width of the ring. The whole surface is further marked by distinct longitudinal striæ, about one one-hundredth of an inch wide. These seem to increase by interpolation of other striæ, which begin to make their appearance when the first ones are one and one-fourth hundredths of an inch wide, and look like a finer set of striæ alternating with the coarser. The diameter of the specimen, supposing the section circular, was about ·84 in the grooves between the rings, and the elevation of the rings is ·03. The distances of four successive rings, from center to center, are ·15, ·18, ·21 and ·21.

Locality. Marshall.



from Winchells drawing

This impression agrees in form, dimensions and distance of rings with *O. dactyliophorum* de Kon. (An. Foss., pl. xvii, 2). But this species is described as having circular striæ without any longitudinal ones. It differs from *O. tenuilineatum* Sandberger (Verstein., Taf. xix, 7) by the greater approximation of the rings, and much more closely striated surface. This species, however, from the "Orthocerasschiefer" of Wissenbach, seems at least to be a close analogue. Our fossil is *perhaps* identical with *O. annulatum* of Hisinger, but I have no access to a description of that species.

NAUTILUS (TREMATODISCUS) PLANIDORSALIS, n. sp.
(non *N. planidorsatus* Portlock.)

Shell small, closely coiled, but the whorls not impressed; section angular, transverse diameter greater than the dorso-ventral. Dorsum perfectly flat and quite broad, marked by a strong longitudinal groove near each lateral boundary. From the dorsal area the surface bends abruptly down the dorso-lateral area, making with the dorsum a slightly rounded angle of 125°. The dorso-lateral area is half the width of the dorsum and is slightly concave. From the dorso-lateral area the surface bends regularly toward the umbilicus, but with an increasing radius of curvature. The umbilico-lateral area is marked by strongly raised, sharp, longitudinal striæ, which, under a lens, are seen to be decussated by fine, raised, transverse striæ, less rigidly direct than the former ones, more strongly marked where crossing the longitudinal striæ, and giving them a kind of moniliform appearance. Indications of longitudinal striæ exist over the whole surface, but the state of the specimen is unfavorable for their exhibition. The septa present a shallow, posterior sinuation in the middle of the dorsum, a similar anterior sinus on the dorso-lateral angle, and a slight posterior sinus on the lower portion of the dorso-lateral area.

Diameter of whorl ·76 (100); greatest transverse diameter of section ·43 (57); dorso-ventral diameter of section ·25 (33); greatest width of dorsum ·22 (29); greatest width of dorso-lateral area ·19 (25); distance of longitudinal striæ ·012 (1·6), giving 8 to one-tenth of an inch; distance of transverse striæ ·008 (1·0), giving 13 to one-tenth of an inch; greatest distance between the furrows on the dorsum ·18 (23); greatest distance between septa, measured on the dorsum ·14 (18).

Locality. Marshall.

The best specimen of this species in my possession is a fragment showing about half of one whorl from the septate portion of the shell. The species belongs to the group of angulated, widely umbilicated *Nautili* for which Messrs. Meek and Worthen have proposed the distinct subgeneric designation *Trematodiscus*

(Proc. Acad. Nat. Sci. Phil., June, 1861, p. 147; and this Jour., [2], xxxii, 174). *N. planidorsalis* bears an extremely close relationship to *N. digonus*, Meek and Worthen, from the Rockford "Goniatite bed" in Indiana (Proc. Acad. Nat. Sci. Phil., Oct., 1860, p. 470). It differs, however, by having a very *distinct* longitudinal groove along each lateral boundary of the dorsal area, and extending apparently the whole length of the shell, while *N. digonus* "is marked by two very obscure lateral depressions near the aperture." *N. digonus* also is "rounded regularly into the umbilicus," from the angle which bounds the dorsal area, while in *N. planidorsalis*, the "regularly rounded" area is separated from the dorsum by a dorso-lateral area which is concave.

NAUTILUS (TREMATODISCUS) TRIGONUS, n. sp.

Shell of moderate size, rapidly enlarging, marked longitudinally by three prominent, obtuse angulations—one dorsal and two dorso-lateral. The dorsal ridge is broadly convex, but the nature of the specimen does not permit me to ascertain whether or not the center is marked by a narrow groove. The dorso-lateral ridge is also regularly curved, and a small concave furrow separates it from the dorsal one. The slope from the dorsal to the dorso-lateral ridge makes an angle of about 65° with the dorso-ventral diameter. A broad, shallow lateral furrow succeeds the dorso-lateral ridge, and this is followed by a regular convexity descending into the umbilical cavity. The transverse diameter through this convexity is scarcely greater than that through the dorso-lateral ridges. The surface (of the cast) is smooth. The septa are rather deeply sinuous—a strong sinus turned backwards, occupying the dorsum, and a deep broad sinus, the side, these two being separated by an abrupt saddle whose apex rests upon the dorso-lateral keel.

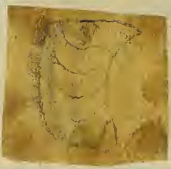
Measurements, of a fragment forming less than half a volution, wholly septate. Dorso-ventral diameter ·45; transverse diameter about ·54; distance from dorsal to dorso-lateral ridge ·18; depth of dorsal sinus ·07; of lateral sinus ·14; interseptal distance on the dorsum ·17.

Locality. Marshall.

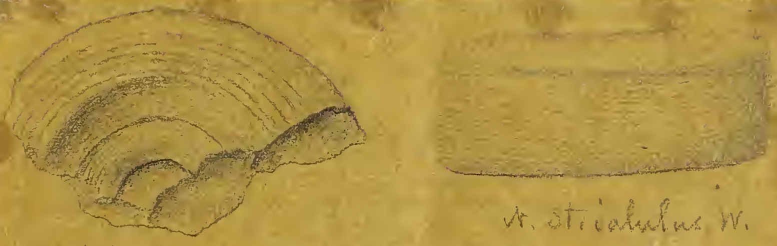
NAUTILUS (TREMATODISCUS) STRIATULUS, n. sp.

Shell small, rapidly enlarging, whorls not impressed, flattened on the dorsum on each side of the peripheral line, and thence rounded regularly into the umbilical expanse; transverse section somewhat elliptic, with the major axis corresponding to the transverse diameter of the shell. Septa slightly sinuous, one broad shallow sinus extending across the side and another across the dorsum. Surface finely and elegantly fluted longitudinally.

The largest fragment of this species is about half a volution,



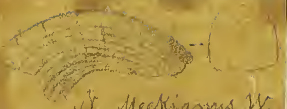
Naut. trigonus, W.
From Winchells drawing



N. striatulus W.

N. striatulus W.

From Prof. Winchell's drawings



N. Meekianus, W.

From Winchell's drawings

wholly septate, and about 1·18 (100) across; dorso-ventral diameter at larger end ·41 (34); at smaller end ·34 (29); transverse diameter at smaller end ·38 (32); interseptal space on the dorsum ·16 (14); distance of striæ ·025, giving 4 in one-tenth of an inch.

Locality. Marshall.

The above species agrees with Hall's brief description of *Gyroceras gracile* (13th Rep. N.Y. Reg., p. 105), except in the abrupt undulation of the septa upon the dorsum. Though the position of the siphon is not satisfactorily ascertained, there are some indications that it is excentric though not marginal. The striately fluted surface recalls some species of *Gyroceras* figured by de Koninck.

NAUTILUS (TREMATODISCUS) MEEKIANUS, n. sp.

Shell small, rapidly enlarging, whorls not impressed, flattened across the dorsum, and even slightly concave along the peripheral belt; sides obtusely angulated by the flattening of the dorsum, the slope from the lateral angle being a regular curve into the umbilicus. Transverse section, in consequence of the dorsal furrow, somewhat cordate. Surface below the lateral angle, distinctly striate; above it, very obscurely so. Septa forming a very shallow sinus just below the lateral angle, and another, considerably deeper, across the dorsum.

Diameter of whorl (wholly septate) 1·25 (100); dorso-ventral diameter ·40 (32); transverse diameter ·40 (32); interseptal space on the dorsum ·18 (14); depth of lateral sinus ·04 (3); of dorsal sinus ·07 (6); distance of striæ ·04, giving two and a half in one-tenth of an inch.

Locality. Marshall.

The present species is closely related to the foregoing, but differs by a more depressed dorsum and coarser striation.

NAUTILUS (TREMATODISCUS) DISCOIDALIS, n. sp.

Shell of moderate size, flattened dorsally and laterally; lateral surface but slightly convex, its width nearly equal to the height of the shell; umbilical slope regularly curved, making an angle of about 120° with the side. Dorsum making a right angle with the side, but the character of the peripheral belt has not been seen. Cast longitudinally striated or grooved, indistinctly so on the sides, while a raised line gives prominence to the dorso-lateral angle. Septa forming a broad moderately deep sinus, which extends across the entire lateral surface; another one exists upon the dorsum.

A completed volution, wholly septate, measures 1·6 (100); dorso-ventral diameter ·56 (35); transverse diameter unknown, but the umbilical slope on one side is ·22 (14); lateral surface ·38 (24); distance of striæ on the umbilical slope ·028 (2), which gives 3½ to one-tenth of an inch; depth of lateral sinus ·08 (5).

Localities. Marshall and Battle Creek.

NAUTILUS SUBSULCATUS (?)

Phillips (Geol. Yorks., ii, 233, pl. xvii, 18, 25).

The general outline of the transverse section is hexagonal, with well rounded angles. The sides are nearly plane, and parallel with the dorso-ventral diameter, and in the ventro-lateral region slope abruptly into the umbilical cavity, making an angle with the side, of about 65°. The lateral surface joins the dorsal at an angle varying from 74° to nearly 90°. At a little less (apparently) than half the transverse diameter of the cast, the dorsum shows a small rectangular carina, similar to the one represented by de Koninck in pl. xlix, fig. 4 *b*. The nature of the surface between this carina and the corresponding one on the opposite side of the peripheral line, has not been ascertained. The septa make a broad sinus coextensive with the lateral surface, and curve backwards again upon the dorsum. The angle of intersection with the sides shows that they are deeply concave. The inner whorl is somewhat impressed into the outer. External surface of cast is faintly marked by raised striæ crossing in lines parallel with the septa; and on the umbilical slope are seen traces of coarser longitudinal striæ.

Greatest dorso-ventral dimension ·8; width of lateral surface ·6; width of dorsal surface to carina ·27; width of ventral surface to impression of next inner whorl ·38; interseptal space on the dorso-lateral angle ·33; distance of transverse striæ ·02, giving 5 in one-tenth of an inch; distance of longitudinal striæ ·04, giving 2½ in one-tenth of an inch. A fragment of a larger specimen (wholly septate) must have belonged to an individual more than 4 inches across the outer whorl. In this, the lateral surface is ·8, and the umbilical slope ·47.

Locality. Marshall.

The transverse section of these forms is much less sharply angular than is shown by the figures of European authors, and the striæ seem to be coarser.

NAUTILUS INGENTIOR, n. sp.

Shell very large; whorls not impressed; transverse section an ellipse whose larger diameter corresponds to the height of the shell, the sides in some specimens being somewhat flattened. Surface (of cast) smooth; septa bent abruptly forward at their junction with the shell so as to meet it at an acute angle, slightly sinuous,—a broad shallow sinus occupying the superior lateral portion of the surface; dorsum not seen.

One fragment in my possession 3½ inches long, one-half septate, must have belonged to a specimen more than 7 inches across the outer whorl. The dorso-ventral diameter at the last septum is about 1½ inches; last interseptal space ·42 near the dorsum; depth of lateral sinus not more than ·10. Another specimen, wholly septate, supposed to belong to this species, though more rapidly curved, is 1·85 from the dorsal to the ventral side.

Locality. Marshall.

This species most nearly resembles the preceding, but differs in the absence of an angular section and the two sets of striæ. Among foreign species it recalls *N. ingens* Martin, but the section is less circular and the septa are more sinuous.

CYRTOCERAS TESSELATUM?

de Kon. (An. Foss., p. 529; pl. xlviii, 5).

A mere impression, undistinguishable from the above, seems to possess sufficient interest to deserve mention. It is one inch long and four-tenths broad, and could not have been made by any body which has heretofore come under my observation from the Marshall sandstone.

GONIATITES MARSHALLENSIS, n. sp.

For figure see page opposite 258.

Shell rather long, consisting of at least four whorls, the inner moderately impressed into the outer; transverse section varying from an ellipse of small excentricity to an oblong figure; surface smooth. Aperture and outer chamber not seen. Septa close, the lobes almost reaching the next posterior saddles. Dorsal lobe twice as long as its greatest width, clavate, with a long cuspidate acumination, at the extremity of which can sometimes be seen the outline of the minute siphon; first and second lateral lobes similar to the dorsal in form, but successively a little smaller and not acuminate; accessory lobe obtuse, half the size of the second lateral; ventral lobe profound. Dorsal and lateral saddles of form similar to the principal lobes, but regularly rounded at the extremity; first accessory saddle, half the size, the second, imperfectly developed.

Diameter of largest specimen seen 1·75 (100); major axis of transverse section ·59 (34); minor axis ·47 (27); length of dorsal lobe ·26 (15), of which the cusp is about ·07 (4); greatest breadth ·12 (7). Diameter of siphon ·015 (0·9).

Localities. The most abundant Goniatite in the feebly cemented, ferruginous sandstone at Marshall. Found also in a similar rock at Moscow, and numerous other localities in Hillsdale and Jackson counties. It occurs in the hard bluish calcareous sandstone at Battle Creek and in the hard purple sandstone at Hard Wood Pt., Saginaw Bay.

This Goniatite belongs to the group which embraces *G. Henslowi* Sow., *G. serpentinus*, *cyclolobus* and *mixolobus* of Phillips, but after careful study it seems sufficiently distinct from all. Its closest European analogue is *G. mixolobus*.Phil., from the Mountain limestone of the Isle of Wight and the "Posidonomyenschiefer" of Wiesbaden. Its nearest American analogue seems to be *G. Lyoni* Meek and Worthen (Proc. Acad. Nat. Sci. Phil., Oct., 1860), with which Prof. Hall's *G. Hyas* is identical (see 13th Rep. Regents N. Y., p. 102). The Michigan species, however, differs from the Rockford one in the addition of an accessory lobe and saddle, and in the dorsal lobe being broader and relatively longer. It is also somewhat more involute.

GONIATITES HOUGHTONI, n. sp.

Shell moderately long, whorls but slightly impressed, almost evolute; transverse section elongate-oval, abruptly rounded at the dorsal and ventral extremities, and nearly flat on the sides. Surface of shell apparently smooth. Septa rather remote. Dorsal lobe infundibuliform, attenuately acute, length equal to breadth of its base; first lateral lobe clavate, acute, twice as long as broad, reaching as far back as outer lobe; second lateral lobe of the same form as the first but somewhat larger; accessory lobe present, but not distinctly seen. Saddles all regularly rounded at the extremity; the dorsal, broadest at the base, the other two clavate and reaching one-third their length further forward than the dorsal.

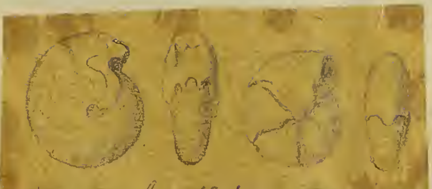
Greatest diameter 1·75 (100); major axis of transverse section ·42 (24); minor axis ·21 (12); length of dorsal lobe ·12 (7); distance from tip to tip of two contiguous dorsal lobes ·24 (14).

Locality. Marshall.

Resembles the preceding but differs materially in the form of the dorsal lobe and the transverse section. It differs from *G. Lyoni* Meek and Worthen, in the greater relative length of the second lateral lobe and the first accessory saddle, as also in the more appressed transverse section. Its closest affinities are with *G. Henslowi* Sow., but differs in the more acute lateral lobes, and relatively longer lateral and accessory saddles.

GONIATITES ALLEI, n. sp.

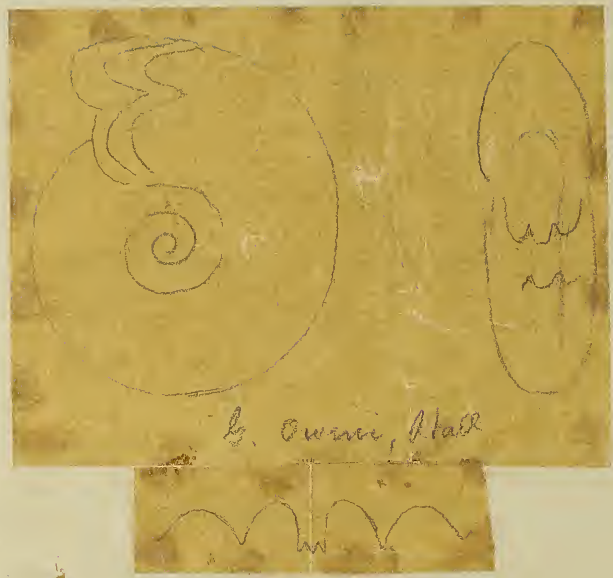
Shell laterally compressed, the inner whorls impressed to the middle of the outer; umbilicus very small, not disclosing any of the inner volutions; aperture auriculate. Section (of an entire whorl) through the umbilicus, at right angles with the siphon, an elongated ellipse. Surface unknown, but the cast is marked along the dorsal region by minute, irregular, revolving striæ. Dorsal lobe wanting or too minute to be detected in sandstone casts. First lateral lobe acute, terminating at an angle of about 60°; second lateral lobe extending as far back as the first, its apex in the form of a low gothic arch, body of the lobe campanulate, equilateral. Dorsal saddle parabolic, not



G. allei, W.

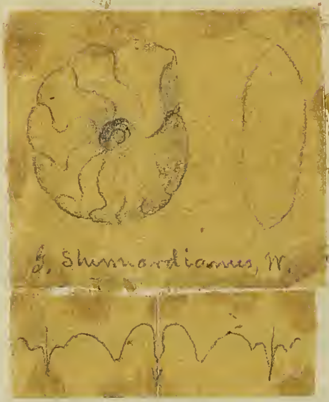
G. allei, W.

From Winchell's drawings



G. Owenii, Hall

Copied from Whitfields
drawing



G. Shumardianus, W.

G. Shumardianus, Win

distinctly indented at the apex by a dorsal lobe; lateral saddle nearly twice as long as the dorsal, its apex rounded and slightly turned toward the umbilicus, its width equal to its height, size a little larger than the second lateral lobe; accessory saddle projecting nearly as far forward as the lateral, but twice as broad, and flatly rounded anteriorly. Ventral lobe small, but profound, and separated on each side by a narrow, rounded saddle from another small lobe upon the ventral surface of the whorl.

Greatest diameter of shell as far as seen ·72 (100); width of aperture between the auriculations ·21 (29); distance from tip to tip of two dorsal lobes nearest the aperture ·15 (21); distance between striæ on dorsal surface of cast ·004.

Localities. Marshall and Jonesville.

The side view of this species resembles that of *G. uniangularis* Conrad, but the details of the septa are materially different. It has affinities with *G. carinatus* Boyr., and *G. lamed*, var. *complanatus* Sandb., from the "Cypridinenschiefer" in Nassau, but differs from both in its closed umbilicus, the want of a dorsal lobe, and the presence of an accessory saddle, which, in our species, is as prominent as the lateral one.

GONIATITES OWENI,
Hall (13th Rep. N. Y. Reg., p. 100).

A Goniatite common in the sandstone which is the prolongation of the beds at the grindstone quarries, on the shore of Lake Huron, in the vicinity of Pt. aux Barques, presents all the essential characters of *G. Oweni.* Comparing it however with figures and descriptions of this species, as well as with specimens from Rockford, Ind., our fossils are somewhat more compressed laterally, the septa are more approximated, and the lateral lobes lie along the middle of the lateral surface, instead of considerably nearest the dorsal region.

Prof. Hall's var. *parallela* (*parallelus?*) is also distinctly represented at the same localities, but it is to be remarked that in this variety the umbilicus is *more* open instead of *less* so.

GONIATITES SHUMARDIANUS, n. sp.

Shell of moderate size, laterally compressed; dorsal surface narrowly rounded, dorso-lateral surfaces but slightly convex, making with each other an angle of about 27°, abruptly inflected into the moderately open umbilicus, which reveals a small portion of two or three preceding whorls; greatest width of transverse section (near the umbilicus) two-thirds the dorso-ventral dimension. Septa rather remote. Dorsal lobe not satisfactorily defined, but apparently simple, sharply acute, with a length about equal to the breadth at the base; first lateral lobe extending as far back as the dorsal, acute, but with a broad base; second lateral lobe wanting. Dorsal saddle parabolic; lateral saddle very broad, and extending one and one-fourth times as far forward as the dorsal, and having its umbilical branch much more abrupt than the lateral one.

Greatest diameter of shell seen 1·02 (100); greatest transverse diameter of section ·33 (32); dorso-ventral dimention ·49 (48); distance from tip to tip of two dorsal lobes nearest the aperture ·23 (23); greatest width of umbilicus ·23 (23).

Locality. From the gritstones in the vicinity of the quarries near Pt. aux Barques.

This species is closely related to *G. Allei*, but is laterally more compressed, with a sharper dorsum, and unlike that, has but one lateral lobe.

GONIATITES PROPINQUUS, n. sp.

see next page

Shell of moderate size, closely involute, with a closed, slightly indented umbilicus; slightly compressed, with a well rounded dorsum, and moderately convex sides making with each other an angle of about 10°. Septa rather remote. Dorsal lobe of medium size, infundibuliform, obtuse; lateral lobe extending half its length behind the dorsal, infundibuliform, slightly rounded at the apex, and with a base equal to the height; second lateral lobe wanting. Dorsal saddle parabolic; lateral saddle somewhat semicircular, but most convex anteriorly.

In the only specimen seen, the dorso-ventral dimension is ·65; the greatest diameter of transverse section (close to umbilicus) is ·43.

Locality. From the gritstones in the vicinity of Pt. aux Barques with *G. Shumardianus* and *G. Oweni.*

Closely related to *G. Shumardianus*, but has a more broadly rounded dorsum, with sides more nearly parallel and wants the open umbilicus. The lateral lobe is also much more produced posteriorly and both lobes are probably a little less acute.

A Goniatite having the general form and appearance of the three preceding species has been found at Marshall, in fragments which are marked by occasional sinuous transvere furrows, and while its single lateral lobe separates it from *G. Allei*, its more rounded dorsum differs from *G. Shumardianus.* Should it prove distinct it may appropriately be called *G. sulciferus.*

GONIATITES SINUOSUS ?

Hall (Geol. Rep. 4th Dist. N. Y., p. 245).

I have in my possession several specimens of an involutely coiled shell which cannot be distinguished by the aid of Prof. Hall's figure and brief description from *G. sinuosus.* At the same time some doubt exists in reference to the Goniatitic character of my specimens. The septa are very imperfectly shown, but by comparing different individuals, it appears that they form a broad (Nautiloid?) sinus, convex *anteriorly*, on the superolateral surface, and another of about the same size on the inferolateral surface. A Goniatitic lobe may connect these two saddles, but it cannot yet be discerned. My specimens are sharply striated transversely in the umbilical cavity. In size and proportions they correspond exactly with the New York species, which occurs in the Portage Group.

GONIATITES PYGMÆUS, n. sp.

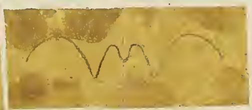
Shell very small, globose, closely involute, with a minute, perforated umbilicus. Whorls divided into quadrants by apertural constrictions. Dorsum regularly rounded, sides convex. Septa moderately angulated; dorsal lobe relatively broad, obtusely rounded, with indications of a slight indentation at the apex; lateral lobe shallow, acute, infundibuliform; dorsal and lateral saddles broad, shallow, circularly curved. Surface (of cast) perfectly smooth.

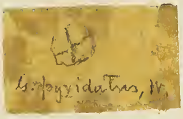
A sole specimen, which seems to embrace a portion of the last chamber is ·25 in diameter; height of section ·13; transverse diameter ·13.

Locality. Supposed to be Battle Creek.

This interesting little species externally resembles *G. planilobus* Sandb. (Verstein., Taf. x, 6, 7), but the septa are more angulated. It differs from *G. striolatus* Phillips (Geol. Yorks., ii, pl. xix, figs. 14–19), by a much smaller umbilicus, larger dorsal lobe and saddle, and much smaller inferior lateral lobe, and (in the cast) by the absence of striæ.

University of Michigan, Ann Arbor, Jan. 30, 1862.




G. pyxidatus, W.

G. propinquus, W.
From Winchells
drawings

2

F. B. Meek
Rec'd Dec. 5th 186

Descriptions of Fossils from the Marshall and Huron Groups of Michigan.*

BY ALEXANDER WINCHELL.

Centronella, Billings.

See p. 12

Centronella Julia, n. sp.—Shell small, nearly circular, ranging from slightly elongate to transverse, and squarely rounded; both valves with regular lens-like convexity, sometimes with a gentle ridge running the length of the ventral valve, and a slight sinuation near the margin of the dorsal. Ventral valve with a moderate beak, circularly foraminated, turned up at a right angle, covering the beak of its fellow. Area entirely wanting. Shell obsoletely striate concentrically, and having a minutely punctate structure. Apophysary system as follows: A delicate ribbon-like loop originates from the stout blunt crura of each side of the socket valve, having its flat sides at first vertical; the two branches of the loop proceed at first in lines parallel or a little convergent, and then gradually diverge, widening as they proceed, and assuming an inclined position, until, approaching the front of the valve by a regular curvature, the lower edge has become anterior, giving the band an angle of 30° with the plane of the shell; approaching the median line the band rapidly widens, and the front margin is drawn forward in a long acumination, while the inner margin is regularly concave, except that near the median line it turns abruptly forward so as to meet that line at an acute angle. The loop thus forms an urceolate figure on its inner margin, and on the outer a somewhat oval one truncated behind and attenuately acuminate before. In the median line where the two branches meet, both are suddenly deflected downwards, forming a double vertical plate, not quite reaching the ventral valve, the upper edge of which, when viewed from the side, is flatly roof-shaped, while the lower edge describes two convexities, the greater, anterior, leaving a notch between them. The surfaces of the loop and median plate are covered with minute obliquely conical pustules, in some places seeming to become spinulous. The casts exhibit on the ventral side a delicate impressed line extending from the beak to the middle, and on the right and left of this a fainter one; on the dorsal side a median impression with two fainter ones on the right, and two on the left—the median terminating rostrally upon a small pyramidal process (filling the beak of this valve) separated by a short slit (made by the socket ridge) from a smaller isolated process on each side.

Length, breadth and thickness of an average specimen: ·31 (100), ·29 (94) and ·15 (48).†

Locality.—Grindstone quarries, Pt. aux Barques, in a conglomeritic ferruginous sandstone overlying the gritstones of the Marshall Group. Abundant.

Spirifera, Sowerby.

Spirifera subattenuata, Hall.—Iowa Rep., p. 504, pl. 1~~0~~, fig. 3. Comp. Owen Rep. on Iowa, Wis., &c., pl. iii. fig. 9. 14

Our specimens agree with the figures and descriptions of Hall.

Locality.—Light-house Pt. aux Barques, with *Spirifera Huronensis*.

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* For a description of the rocks of these groups see the author's Report on the Geology of the Lower Peninsula of Michigan, 1860; also Silliman's Journal for May, 1862.

Descriptions of 26 species of Cephalopoda from these two groups were published in the number of Silliman's Journal just referred to; and descriptions of most of the Gasteropoda and Lamellibranchiata of the present paper were sent for publication on the 1st of April last, since which time further discoveries and investigations have extended my notice of the palæontology of these interesting groups to its present limits, and I have for this reason obtained permission of the editors of Silliman's Journal to offer the whole for publication together, to the Phil. Acad. of Nat. Sciences.

† The measurements in this paper are given in inches. The numbers in parenthesis are the *relative* measurements—that which is generally greatest being assumed 100.

Spirifera medialis (?) Hall.—Rep. IVth Dist. N. Y., p. 208, fig. 8 ; 10th Rep. N. Y. Reg., p. 164.

Locality.—Light-house, Pt. aux Barques, with *S. Huronensis.*

Spirifera Huronensis, n. sp.—Shell of medium size, transversely semi-elliptic, with acuminate hinge-extremities ; entire hinge-length nearly three times the length of the shell; anterior and antero-lateral borders regularly curved. Ventral valve ventricose, especially towards the beak, which is erect over a high, triangular area, triangularly foraminated to the apex ; sinus beginning near the beak, not well defined, round at its margins and bottom ; entire surface covered with about forty rounded ribs, of which the lateral half on each side terminate upon the cardinal border, while about four, of the same size as their neighbors, occupy the sinus. Dental plates standing at an angle of 58°. Dorsal valve equally tumid with the ventral ; beak incurved over a narrow area ; mesial fold indistinct, with three or four ribs ; occlusor and pedicle scars lanceolate, deep. Surface of shell with one or two squamous incremental lines.

Length of shell, ·49 (100) ; length of hinge line 1·3 (265) ; convexity of ventral valve ·25 (50).

Locality.—Light-house Pt. aux Barques, in a hard, gray, pyritous, coarse, often conglomeritic bed of sandstone two feet thick, intercalated in the argillaceous slates of the Huron group.

Spirifera pharovicina, n. sp.—Shell large and ventricose. Ventral valve with a gentle sinuation which extends to the beak ; dental plates moderately long, forming an angle of 80° ; area very elevated, with a narrow triangular fissure reaching to the apex, which scarcely overhangs the area ; surface faintly marked each side of the sinus by rather remote radiating ribs, which, near the margin, are somewhat distinct. Some impressions of areas supposed to belong to this species, are 2·1 long, and ·95 high, with a fissure ·44 wide at base ; deltoidal impression grooved in the direction of the fissure ; surface of area flat, slightly incurved at apex and marked by very distinct transverse striæ. Dorsal valve with a low rounded fold, marked (in the cast) by a single small median groove ; beak prominent, incurved over a small area.

Locality.—Light-house, Pt. aux Barques, with *Rhynchonella Huronensis, Sperifera Huronensis, &c.*

This well marked species is known only by imperfect casts.

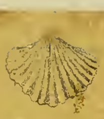
Spirifera (?) insolita, n. sp.—Shell large, smooth. Ventral valve with a broad, concave sinus reaching to the beak, and forming at its lateral margins angles with the shell surface ; area short and imperfectly bounded, though the beak is rather high ; dental plates very long, reaching the middle of the shell or beyond, and forming with each other an angle of 25°, which is the same as the rostral angle of the mesial sinus.

Locality.—Light-house, Pt. aux Barques.

This species has the short hinge line of *Brachythyris*, and the smooth surface of *Martinia*—characters which, with the very long and approximate dental plates render it unique among Spiriferæ.

Retzia, King.

Retzia polypleura, n. sp.—Shell of medium size or rather large, cuneate-oval, tumid. Ventral valve with a prolonged, isolated, nearly erect, perforate beak, which projects one-fourth the valve length beyond the dorsal valve, a swollen umbo, and depressed central and anterior region. Dorsal valve rotund, with a subcuneate rostral margin ; beak obtuse, closely appressed against the ventral valve ; umbo ventricose ; entire valve with a regular cardium-like convexity ; median ridge extending one-third the length of the valve, with a lanceolate occlusor impression on each side of it. Surface marked by about forty small rounded radiating ribs. Spires not seen.



2467
R. sageriana
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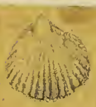


R. camerifera, W.

[illegible]

Length, breadth and thickness of a rather small specimen: ·70 (100), ·58 (83), and ·34 (50). Length of dorsal valve ·52 (74.) Length and breadth of another dorsal valve ·69 and ·66

Locality.—Light-house, Pt. aux Barques with *Rhynchonella Huronensis,* &c.

This species resembles *R. serpentina,* de Kon. (Anim. Foss., 291, pl. xix. 8), but the ventral valve is most ventricose in the umbonal instead of the middle region, and has a nearly erect instead of a straight beak. It differs from *R. vera,* Hall (Iowa Rep. 704, pl. xxvii. 3), in the absence of wings, and in its more erect beak.

MERISTA, Suess.

MERISTA HOUGHTONI, n. sp.—Shell of medium size, subrotund and subtumid. Ventral valve a little produced at the straight, obtuse foraminated beak; somewhat truncate in its contour, along the cardinal slopes, and very slightly elongate in front across the width of the sinus; regularly convex in all directions from the middle, except along the shallow sinus, which takes its origin near the middle of the valve. Impressions of the divaricator muscles longitudinally striate. Dorsal valve circular; beak scarcely projecting beyond the hinge; occlusor impressions small, spatulate, separated by a rostral septum reaching one-fourth the length of the valve; mesial fold represented by an undulation at the anterior margin. Surface of cast smooth.

Length, breadth and thickness ·70 (100), ·68 (97) and ·36 (51).

Locality.—Light-house, Pt. aux Barques, with *Rhynchonella Huronensis,* &c.

RYNCHONELLA, Fischer de Waldheim.

RHYNCHONELLA SAGERIANA, n. sp.—Shell of medium size, somewhat quadrantal in outline, rather tumid. Ventral valve not seen. Dorsal valve in the older specimens with a prominent and inflected beak, and about 16 obtuse plications, some of the central ones showing a groove on the summit toward the margin, as if preparatory to bifurcation. Mesial fold consisting of two or three plications just perceptibly raised above the others in the vicinity of the anterior margin.

Length, ·56 (100); breadth ·60 (107); convexity of dorsal valve ·23 (41).

Locality.—Marshall, in the Marshall sandstone.

RHYNCHONELLA WHITEI, n. sp.—Shell small, sub-circular. Dorsal valve subtumid, with the greatest elevation at one-third the distance from beak to anterior margin; cardinal slopes slightly convex, terminating in subalate spaces which descend from the umbo; lateral and anterior margins circularly rounded. Surface marked by about 17 rounded, moderately elevated ribs. Mesial elevation entirely wanting, or barely perceptible, and embracing about two of the plications. Median septum present, little developed.

Length of dorsal valve ·38 (100); breadth ·45 (119); convexity ·10 (26).

Locality.—Marshall.

RHYNCHONELLA HUBBARDI, n. sp.—Shell small, subquadrantal in outline; cardinal slopes straight, forming a right angle or more; lateral extremities about midway of the shell; anterior border gently curved; the two valves equally convex; ventral valve most tumid near the beak, the dorsal in the middle. Surface marked by 21 small rounded radiating plications. Mesial sinus represented by a broad shallow flattening of the mid-frontal slope of the ventral valve, occupying the two middle-fourths of its width, and corresponding to 8 or 9 plications. No fold perceptible in the dorsal valve, but a shallow depression extends from the beak about one-third the length of the shell, corresponding to the extent of the median partition beneath it. Dental plates of the ventral valve well developed, diverging at an angle of about 30°. Shell thin, fibrous.

Length of a ventral valve ·26 (100); breadth ·31 (119); convexity, ·08 (31).

Localities.—Marshall and the grindstone quarries at Pt. aux Barques, belonging to the Marshall group.

The dorsal valve greatly resembles that of *R. circularis.*

Rhynchonella Marshallensis, n. sp.—Shell of medium size ; dorsal valve very ventricose, with the middle region somewhat flattened, and all the margins abruptly deflected—the anterior at nearly right angles ; beak prominent, obtuse, incurved ; cardinal slopes short, making with each other an angle of about 100°. Surface of valve marked by about 27 medium-sized rounded, radiating plications, two or three of which are implanted on each lateral extremity, some of the plications reaching the beak. A shallow mesial fold rises in about the middle of the valve and embraces seven plications. The mesial septum extends about one-eighth the length of the valve.

Length of the dorsal valve ·58 (100) ; breadth ·62 (107 ; convoxity, ·30 (52).

Locality.—Marshall.

Rhynchonella camerifera, n. sp.—Shell of moderate size, tumid ; beak of ventral valve projecting and slightly upturned ; cardinal slopes straight, at right angles ; sides of the shell rounded ; front margin similarily rounded or somewhat straight, not unfrequently produced on one side of the mesial sinus. Dorsal valve nearly circular, a little more convex than the ventral, most convex anterior to the middle, and rather abruptly bent down in front. Ventral valve with a shallow sinus, which extends back about one-fourth the length of the valve, corresponding to the fold in the dorsal valve ; most convex between the beak and the middle ; dental plates parallel, well developed ; teeth at right angles, elongate, growing stouter anteriorly, with handsomely crenulated margins ; mesial partition of the dorsal valve, extending nearly one half its length, thickening near the beak, to give space for the excavation of a small chamber within the septum. Shell with 20 or 21 (a variety ? with 16) sharp plications, of which three or four are comprised in the mesial sinus ; these are crossed by a few squamulose concentric wrinkles ; shell structure fibrous.

Length of an average specimen ·38 (100) ; breadth ·34 (90) ; thickness, ·19 (50).

Locality.—Pt. aux Barques, in a conglomeritic ferruginous sandstone overlying the gritstones of the Marshall group—myriads of casts sometimes forming, with *Centronella Julia*, the whole mass of the rock.

The small chamber in the mesial septum of the dorsal valve is an interesting and unique character. On a similar cameration of the septnm of the ventral valve of some Cyrtiæ the genus *Cyrtina* has been founded ; and Professor King established his *Camarophoria* on the formation of an arch in the ventral valve by the approximation of the dental plates.

This species has the external appearance of the young of *R. incuebescens,* but, amongst thousands, none attain proportions very different from those given above.

Rhynchonella barquensis, n. sp.—Shell small, transversely oval, thin. Ventral valve with a moderately prominent beak and slightly curved cardinal slopes ; greatest tumidity near the beak, from which the surface descends in a nearly right plane to the anterior margin, and with little convexity to the right and left margins. Dorsal valve flattish, most inflated in the middle. Mesial fold and sinus small, traceable one fifth or sixth the length of the shell, embracing two or three sharp plications, of which the entire surface of each valve receives about 12 or 13. Dental plates of ventral valve parallel ; mesial septum of dorsal valve camerated as in *R. camerifera.*

Length ·30 (100) ; breadth ·32 (107) ; thickness ·13 (43).

Locality.—Grindstone quarries, Pt. aux Barques, with *R. camerifera.*

Rhynchonella subcircularis, n. sp.—Shell small, cuneate-rotund, subtumid.

Ventral valve unknown. Dorsal valve with a blunt depressed beak, equalling the hinge, a moderately elevated umbo from which the surface slopes with gentle convexity to the lateral and anterior margins, and abruptly, with slight excavation, towards the superior portion of the rounded hinge-margins. Surface marked by about 32 fine rounded plications, which reach from the margin half way to the beak. Mesial fold wanting. Mesial septum extending one-fifth the length of the shell.

Length of dorsal valve ·25 (100) ; breadth ·25 (100) ; convexity ·08 (34).

Locality.—Grindstone quarries, P. aux Barques, with *R. camerifera.*

This species is a close analogue of *R. radialis*, Phillips, sp. (Geol. Yorks. 223, pl. xii. 40, 41) from the carboniferous limestone of Bollard.

RHYNCHONELLA HURONENSIS, n. sp.—Shell of medium size, tumid, transversely oval, or nearly circular, with rounded lateral, and cuneate rostral margins. Ventral valve with a straight beak, flattened in the central region, and rather abruptly inflected around the margin, toward the plane of the valve ; mesial sinus beginning with the last third of the shell-length, and consisting of a sudden depression in the antero-marginal slope. Dental lamellæ well developed, very slightly divergent. Dorsal valve with an inconspicuous beak and a mesial fold abruptly elevated and confined to the anterior third of the valve. Median septum reaching two-fifths the length of the valve. Occlusor muscular impressions, semi-elliptic, lying close to the median septum. Shell-structure fibrous. Surface marked with 23 small rounded ribs, of which five occupy the mesial sinus.

Length of the ventral valve ·48 (100) ; breadth ·58 (121) ; convexity ·10 (21).

Locality.—Light-house, Pt. aux Barques, in a hard pyritous sandstone intercalated in the argillaceous slates of the Huron group.

Var. *precipua* differs from the typical forms in being more flattened on the ventral side, with mesial sinus consisting of an abrupt deflection of nearly the whole anterior margin of the valve, forming a right angle with the plane of the valve ; surface with 18 rounded radiating ribs, of which 6 fall in the sinus ; dental plates diverging at an angle of 40°.

ORTHIS, Dalman.

ORTHIS VANUXEMI, Hall (10th Ann. Rep. N. Y. Reg., p. 135).–Shell nearly circular, sub-tumid ; hinge-line very short. Dorsal valve a segment of a sphere ; beak not surpassing the hinge, slightly incurved ; a thick median plate or ridge reaching nearly to the centre of the valve, bisecting the right angle formed by the well developed socket ridges. Ventral valve flat, or slightly concave anteriorly, with a projecting beak ; median ridge feeble, extending scarcely to the mid-valve ; a barely perceptible trace of the semi-circular divaricator impressions sweeping from the beak to the anterior extremity of the median ridge, in the middle of which space are the two small semi-elliptic occlusor scars ; dental plates short and thick ; teeth well developed, lying in the hinge-line. One of the casts differs in having one of the occlusor scars half heart-shaped and the dental plates more slender. Surface not fully known ; marked by numerous radiating striæ which increase by implantation and bifurcation, and produce a crenulated anterior margin. Shell structure finely punctate.

Length ·81 (100) ; breadth ·81 (100) ; thickness ·25 (31).

Locality.—Light-house, Pt. aux Barques, with *Rhynchonella Huronensis, &c.*

This shell is a little more convex in the dorsal and flatter in the ventral than the figures given by Prof. Hall, but none of its characters differ materially from his description. Compared with *O. Michelini*, Lev., as described by de Koninck, it is a little more convex dorsally, and presents circular instead of digitate [from the vascular system ?] divaricator impressions upon the ventral valve. *O. Vanuxemi* is described from the shales and shaly sandstones of the Hamilton group of New York and Iowa, the lithographic limestones of Missouri, and from the soft sandstones in Eastern Ohio, regarded as Chemung by Prof. Hall.

ORTHIS CRENISTRIA ? Phillips. (Pal. Foss. Corn. &c., p. 66, pl. 27, fig. 113).—Hinge line equalling greatest width of shell; ventral valve semi-elliptic with shallow constrictions beneath the cardinal extremities ; flat, with an umbonal elevation beginning about the middle and rising to a beak which overlooks a large triangular area inclined at an angle of 45° with the shell-plane ; dental plates strong, each equalling one-fourth the hinge length, forming with each other an angle of about 60°. Occlusor scars reaching nearly the middle of the shell, closely contiguous, leaving together a ligulate anteriorly acute depression upon the cast. Surface covered by fine radiating striæ, interrupted by distinct or obscure concentric wrinkles. In one specimen supposed to belong here, the surface is covered by a set of sharply-cut, twice-dichotomizing striæ—the second set reaching half way, and the third one-third the distance to the beak. Dorsal valve hemispherically convex with sharp striæ and concentric wrinkles, like the ventral.

Length of shell 1·27 (100) ; length of hinge line 1·37 (107) ; length of dental plates ·32 (25).

Locality.—Light-house, Pt. aux Barques.

I can make no distinction between this species and that described by Phillips, from South Devon. The beak, however, seems to be perfectly symmetrical, and in this it differs from *Streptorhynchus robusta*, Hall, sp., from the coal measures of Iowa, as well as from the Punjab examples of Davidson (Quar. Jour. Geol. Soc. Lond., xviii. p. 30), who identifies the Devon, Iowa and Punjab forms. The Michigan forms differ from all the others in the rugose exterior, giving it sometimes the aspect of *Strophomena rugosa* ; but as they at the same time differ among themselves, I am not disposed to hesitate in the identification.

ORTHIS IOWENSIS ? Hall. (Io. Rep., 488, pl. 2, fig. 4.)—Some casts in my possession resemble those of the above species. Ventral valve nearly circular, regularly convex, with deep pit in the beak between the dental plates, which in the cast produces a conical projection. Middle region of cast with three faint rounded ridges radiating from the beak to the anterior margin.

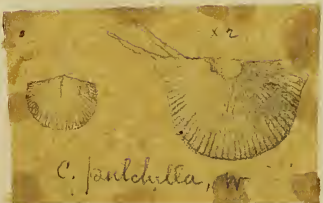
Locality.—Light-house, Pt. aux Barques.

CHONETES, Fischer.

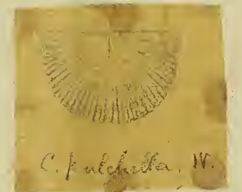
CHONETES PULCHELLA, n. sp.—Shell small, nearly semi-circular ; hinge almost equalling the greatest width, rectangular at the extremities, furnished with two or three stout hollow spines on each side of the beak, one projecting from the hinge extremity, and diverging at an angle of about 22° with the hinge line—the second half way to the beak and diverging at an angle of 45°, each of these spines having a length equal to half the hinge line. Ventral valve, exclusive of the flattened hinge angles, spherically convex ; internal median ridge extending to the middle of the valve. Surface with about 54 feeble, rounded ribs, often nearly obsolete on the hinge angles ; these are crossed by numerous microscopic, concentric striæ ; the grooves beneath the ribs are acute and bear a few spinous projections near the shell margin. Dorsal valve nearly flat, generally a little concave near the margin, marked like its fellow with radiating striæ, and often a few concentric folds. Area very narrow, equally excavated in the two valves. Some specimens exhibit a shorter hinge line, and a flatter ventral valve, elevated only in the umbonal region, with a beak projecting slightly beyond the hinge.

Length ·30 (100) ; breadth ·38 (126) ; convexity of ventral valve ·07 (23).

Localities.—Hillsdale county at Moscow, N. W. ¼, N. W. ¼, Sec. 4, Jefferson,



C. pulchella, W.



C. pulchella, W.

See remarks p. 11

and S. W. ¼, S. W.¼, Sec. 26, Allen. These localities are all in the lower part of the Marshall sandstone.

The variety of this species somewhat resembles *C. Michiganensis*, Stevens. (Sill. Jour. [2] xxv. p. 263), but the spines and ribs are much less numerous, not to speak of the alleged direction of the spines in Dr. Stevens' species.

Chonetes setigera ? Hall. (Geol. Rep. 4th Dist. N. Y., p. 180; 10th Rep. N. Y. Regents, p. 150).—Shell small, semicircular, flattened; hinge line slightly less than greatest width; ventral valve regularly convex, except upon the flattened hinge angles; median ridge feeble; hinge with two (perhaps three) strong diverging spines each side of the beak; dentigerous plate with four tooth-like elevations each side of the beak, slightly elongated in a direction at right angles with the cardinal spines. Surface marked by about 80 minute diverging striæ, obsolete except near the border, and sometimes one or two distinct concentric wrinkles. Dorsal valve slightly concave, striated nearly to the beak.

Length ·25 (100); breadth ·36 (145) convexity of ventral valve ·04 (16).

Locality.—Union, Branch county, in argillaceous shales of the Huron group.

This species differs from the New York specimens of *C. setigera* in the inclination of its spines, and the much greater number of radiating striæ.

Producta, Sowerby.

Producta concentrica, Hall. (Iowa Geol. Rep., p. 517, pl. vii. fig. 3; 10th Rep. N. Y. Reg. p. 180.)—All my specimens of this species from the southern part of the State exhibit, like the Iowa ones, only the inside of the concave valve. On the other hand, fragments of a species supposed to be the same, from the grindstone quarries at Pt. aux Barques, present only the exterior of the convex valve, a circumstance which may throw suspicion on the identification of the two sets of forms.

+ Myalina, de Koninck.

Myalina Michiganensis, n. sp.—Shell of medium size, oblique, equivalve, inflated, posteriorly winged, with a straight hinge line. Beaks compressed, acute, incurved, and slightly directed forward, but little elevated above the hinge line; posterior margin very slightly concave below the extremity of the hinge; thence describing a semi-circle or more to the middle of the anterior margin, where a deep incurvation exists, bounded by a small pouch-like expansion which projects a little anterior to the beaks. Anterior umbonal slope somewhat vertical to the shell-plane; the posterior gradual, towards the margin becoming nearly parallel with the same plane. Hinge furnished in the left valve with two small, curved diverging teeth just anterior to the beaks; behind the beaks a narrow ligamental area extends the whole length of the hinge; this area is marked by three longitudinal slightly diverging furrows—the outer parallel with the hinge line and co-extensive with it, the middle reaching the inner border of the ligamental area at two-thirds the distance from the beak to the hinge extremity, the third meeting the same border still nearer the beak. Surface marked by irregular, fine incremental lines, some of which are more deeply impressed.

See nex
intercalate
leaf

Greatest dimension of shell from beak to ventral margin along the umbonal slope 1·25 (100); angle included between this line and hinge line 50°; diameter of shell from umbo to umbo ·78 (62); length of hinge ·67 (53); angle formed by hinge line and posterior margin 112°—120°; projection of shell anterior to the beaks, ·19 (15).

Localities.—Marshall (abundant), Moscow: This interesting species resembles *M. virgula*, de Kon. (An. Foss. 127, pl. vi. 3). It is, however, less oblique, less indented on the posterior border, and more prominent in front of the umbo.

+ Mytilarca, Hall & Whitf.

Myalina imbricaria, n. sp.—Shell rather small, very oblique, inflated. Beak (of left valve) compressed, acute, incurved, scarcely rising above the hinge; posterior margin straight, making a very obtuse angle with the hinge line; ventral margin regularly curved; anterior, with a rather deep sinus a little above the middle, and a slight projection in front of the umbo. Hinge line straight, equal to the greatest antero-posterior dimension of the shell. Umbo abruptly convex on both sides, but posteriorly blending with the flattened expansion below the hinge. Surface strongly marked by imbricating lamellæ.

Length along the umbonal slope about 1·04 (100); this line forms with the hinge line an angle of 29°; length of hinge line ·70 (67); angle formed with posterior border 53°; projection of anterior margin beyond the beak ·07 (67).

Locality.—Moscow, Hillsdale county, in the Marshall sandstone.

This species differs from its analogue *M. lamellosa*, de Kon. (An. Foss. 126, pl. iii. 6) by its sharper posterior angulation, and deep anterior sinus in the margin.

Myalina rara ~~aviculoides~~.—Shell small, oblique, with subcentral beaks, scarcely rising above the straight hinge line. Right valve unknown; left produced anteriorly just beneath the hinge; anterior margins parallel, forming an angle of about 70° with the hinge line; midumbonal slope forming the same angle, having its anterior declivity convex, its posterior at first convex, then slightly excavated, giving an extended appearance to the posterior margin, but without any perceptible isolation of a posterior wing; ventral margin regularly curved. Surface marked by faint incremental lines.

Length along umbonal slope ·34 (100); length of hinge line ·31 (91); greatest antero-posterior dimension ·32 (94).

Locality.—Marshall.

Myalina pterineæformis, n. sp.—Shell small, equivalve, obliquely elongate, with an alate posterior expansion, which is suddenly thickened above to form the basis of the straight elongated hinge line. Beaks subterminal, obtuse, incurved, elevated a little above the hinge; midumbonal slope making an angle of about 35° with the dorsal margin; from the upper portion the declivity is steep to the hinge on the posterior side, while on the anterior side the shell swells out into a sort of pouch, projecting beyond the beak; posterior margin of shell showing a sinuation just below the hinge, from which a regular curve sweeps around to the anterior side. Shell thin, with fine incremental lines.

Length of shell along dorsal margin ·44 (100); length from beak along midumbonal slope ·38 (86); distance from beak to anterior extremity, ·10 (22); to posterior ·34 (78); diameter of shell through umbo ·12 (24).

Locality.—Pt. aux Barques, from a friable and ferruginous sandstone overlying the grindstones.

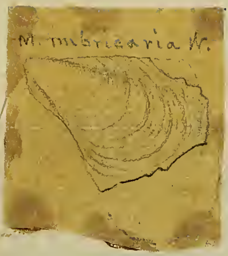
Pterinea, Goldfuss.

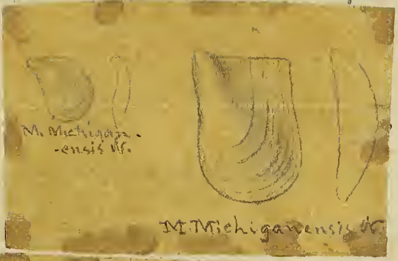
Pterinea cardinata, n. sp.—Shell small, hinge line extremely elongate, posteriorly terminating in an angle of 40°, separated by a slight sinuation from the body of the shell; ventral margin transversely semi-elliptic; anterior wing short, saccate; anterior margin forming with dorsal line an angle of about 45°. Beak flattened, not elevated above the hinge; umbonal slope terminating at the middle of the ventral border, opposite which is the greatest width of the shell; descent from the umbonal slope to the antero-ventral border very abrupt. Surface of cast showing numerous faint concentric grooves which are most conspicuous in the postumbonal region.

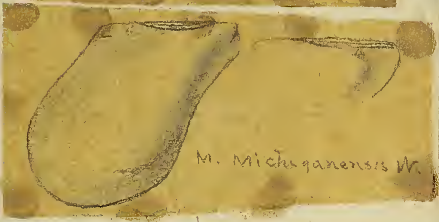
Length of hinge ·65 (100); greatest width of shell ·21 (32); convexity of right valve ·06 (9); length of anterior wing ·06 (9).

Locality.—Grindstone quarry, Pt. aux Barques, with *Rhynchonella camerifera*, &c.

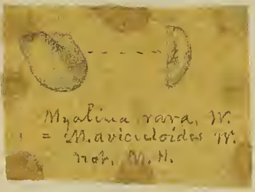
Mylitarca H. Whitf.

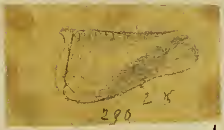

M. imbricaria W.


M. Michigan-
-ensis W.
M. Michiganensis W.

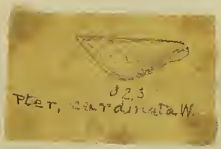

M. Michiganensis W.

See p. 2.11 for descrip.

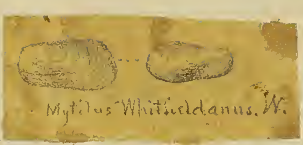

Myalina rara, W.
= M. aviculoides W.
not, M. H.



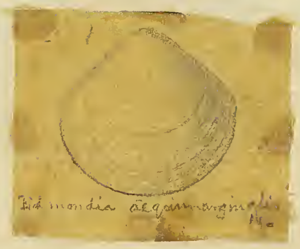
Myalina pterineaeformis, W.

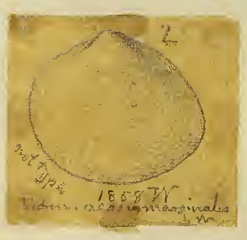


Conf. I. Whitei p. 8.

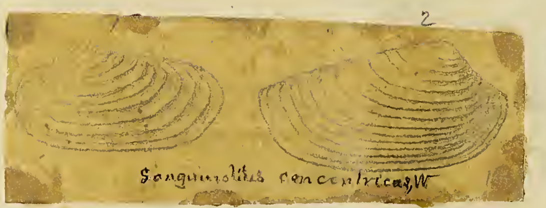

Mytilus Whitfieldanus. W.

Comp. Cypricardia.
Chouteauensis Swallow




2
not type
1858 W.
Edmon. aequimarginalis W.

These shells were both marked Edmondia aequimarginalis among Prof. W.'s drawings, though he stated that fig. 2, was not drawn from the typical specimen. They seem to me to belong to two quite distinct types, the latter being almost certainly a Schizodus, or Prisconaia, if the latter is really distinct from Schizodus. I do not think No 1 either an Edmondia, or a Cardinia



Almost certainly a Palaeoneilo

Fig. 2, if the same sp. must have had the dorsal margin broken off or covered in the matrix
2 casts I have seen from Wooster Ohio have led me to suspect that this shell has a crenulate hinge, and that it.

This species differs from *P. elongata*, Goldf. (Petref. Germ. ii. 135, Taf. cxix. 5), in having a much smaller body, and less distinct from the alate extremities.

*MYTILUS, Linnæus.

MYTILUS WHITFIELDIANUS, n. sp.—Shell small, ventricose, transversely elongate, very oblique, with terminal beaks. Hinge line two-thirds the length of the shell, forming a rounded, very obtuse angle with the somewhat circular posterior border; ventral border slightly arcuate, more rapidly curved beneath the beaks. Greatest width opposite the posterior extremity of the hinge-line. Umbonal ridge elevated, crowded over towards the hinge line, and rendered somewhat angular, more sharply so towards the beak. Surface of shell and cast marked by numerous concentric lamellose lines. One of the best preserved specimens shows distinctly a multitude of minute diverging striæ running in all parts of the surface at right angles with the lines of growth.

Length from beak to posterior extremity ·59 (100); greatest height ·29 (50); length from beak to extremity of hinge line ·44 (75); convexity of right valve ·12 (20).

Localities.—Holland, Ottawa county and Marshall.

CARDINIA, Agassiz.

CARDINIA COMPLANATA, n. sp.—Shell of moderate size, ovoid, compressed, with sub-central beaks. Ventral border gradually curved to the abruptly turned extremities, from which the outline is nearly straight along the cardinal slopes to the obtuse incurved beaks; line joining extremities equidistant from beaks and ventral margins. Right valve flattened, producing an angular fold along the postero-dorsal declivity near the hinge line. Exterior sculptured by about 20 broad regular furrows parallel with the ventral border. Other characters unknown.

Length 1·2 (100); height ·64 (53); length of anterior cardinal slope to extremity of shell ·64 (53); of posterior ·87 (72); convexity of right valve (perhaps mechanically compressed) ·13 (11).

Locality.—Union, in Branch county, in blue argillaceous shales of the Huron group.

CARDINIA ÆQUIMARGINALIS, n. sp.—Shell of medium size, tumid, beaks central, anterior and posterior hinge-slopes at right angles with each other, straight, very nearly equal and symmetrical; extremities rounded, situated about midway between beaks and ventral margin, which is regularly arcuate between the extremities; posterior extremity a little more acute than the anterior. Shell tumid, regularly convex, slightly truncate along the antero-cardinal slope. Beak (of cast) marked only by obscure incremental lines and nearly obsolete concentric furrows. Hinge structure unknown. [illegible] v. 12

Length of shell ·91 (100); height ·86 (94); thickness ·50 (55.)

Locality.—Marshall.

Cardinia robusta, J. de C. Sowerby is a close representative of this species, but is not so high, and is more produced and angulated posteriorly.

Sanguinolites
CARDINIA CONCENTRICA, n. sp.—Shell of medium size, ventricose, transversely elliptic, with subequal extremities and marked ventral enrolment. Beaks appressed, incurved, rising little above the hinge, distant one-fourth the shell-length from the anterior end; umbo and middle of the shell flattened antero-posteriorly; antumbonal ridge inflected towards the hinge, forming above a lunuliform area; dorsal and ventral borders sub-parallel in the adult shell; posterior end obtusely, or at length truncately rounded; anterior end paraboloid. Hinge line straight and rather extended posteriorly. A broad shallow inconspicuous sinus extends from the posterior ventral margin towards the beak. External surface marked, towards the beak, with remote, equidistant, raised, concentric striæ and intervening flat belts; towards the margin

Vertical

See p. 128

* Mytilarca, and not distinct from Mytilarca (Mytilus) fibristriatus, White & W., according to Hall & White)

the striæ gradually become sharp ridges, and the intervening belts deep furrows—these characters being especially strong at the anterior end; whole surface marked by faint incremental lines. Greatest convexity of shell considerably below the middle.

Length 1·30 (100); height ·55 (42); convexity of left valve ·24 (18; whole number of furrows on exterior 14.

Localities.—Hillsdale county at Jonesville, and S. E. ¼ S. W. ¼, Sec. 33, Adams.

Differs from *C. complanata* in its greater relative transverse dimension and its vertical enrolment. It may yet prove to be a *Grammysia.*

Edmondia, de Koninck.

Edmondia binumbonata, n. sp.—Shell of moderate size, rotund-quadrate, very tumid. Hinge line short, posterior to the beaks; posterior margin forming with it a very obtuse angle; anterior slope straight, forming a rounded right angle with the slightly curved ventral border which is nearly parallel with the hinge line, and joins the posterior slope by a regular curve. Beaks depressed and incurved; greatest thickness through the middle of the shell; principal umbonal slope running to the posterior extremity of the ventral border; a subsidiary one running to the anterior extremity; between these the surface is subcylindrical; anterior to them it descends abruptly to the anterior margin, while behind them it sinks at first rather abruptly, and near the posterior border presents a little flattening. Surface (of cast) marked by eight or ten concentric furrows. Anterior lunule excavated.

Distance measured along the principal umbonal slope ·85 (100); length from anterior to posterior extremity ·85 (100); anterior slope ·59 (69); convexity of right valve ·24 (28); angle between anterior cardinal slope and principal umbonal line 70°.

Locality.—Marshall.

Closely related to *E. scalaris*, McCoy (Brit. Pal. Foss. 502, pl. 3 H, fig. 6), from the carboniferous limestone of Lowick, but the anterior extremity is produced into a rounded angle instead of being truncated.

Orthonota, (Conrad), McCoy.

Orthonota rectidorsalis, n. sp.—Shell of moderate size, tumid, elongate transversely with subterminal beaks and gaping extremities. Hinge margin straight, reaching nearly to the posterior extremity of the shell, somewhat elevated; ventral margin straight, and parallel with the dorsal; posterior extremity truncately rounded, making with the dorsal margin an anterior angle of 105°; anterior end slightly gaping two-thirds the width of the shell, rounded abruptly above, gradually below; beak scarcely elevated above the dorsal line, flattened, incurved, with a conspicuous lunule in front; umbonal swelling running to the lower posterior angle. Hinge apparently edentulous and simple; pallial and muscular impressions undiscernible; a deep groove runs from beneath the beak to the anterior extremity, which interrupts the concentric lines shown on the interior of the shell. The cast shows five or six very faint lines diverging from the beak along the superumbonal slope.

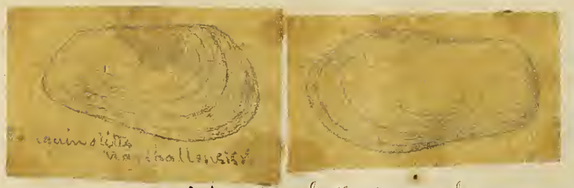
Length 1·48 (100); height ·44 (30); convexity of right valve ·10 (7); length of anterior end ·25 (17).

Locality.—Moscow, Hillsdale county.

This shell agrees tolerably well with *Orthonota*, as modified by McCoy. The gaping extremities and general outline perhaps indicate affinities with *Solen.*

Sanguinolites, McCoy.

Sanguinolites unioniformis, n. sp.—Shell small, compressed, transversely ellipsoidal, with subterminal beaks. Hinge line straight, a little shorter than the shell at both extremities; hinge consisting only of a long, sharp, laminar lateral tooth behind the beak. Anal margin obliquely subtruncate, as



Sanguinolites Marshallensis, Winch.

Comp. *Mytilus Tzschofi*, Vern. Geol. (Russ. Paläont.) pl. XIX, fig. 17.

also the supero-buccal region; ventral border very slightly curved. Beaks subterminal, flat, not projecting beyond the dorsal line. Anterior muscular impression circular, deep, behind which is a clavicular process extending from beneath the beaks, at right angles with the dorsal line, half way across the valve. Cast nearly smooth, but marked by a few concentric undulations. Shell very thin, marked simply with fine incremental lines.

Length ·84 (100); height ·39 (46); convexity of one valve ·11 (13); projection of anterior extremity beyond the beak ·12 (14).

Locality.—Sec. 29 Moscow, Hillsdale county.

Sanguinolites Marshallensis, n. sp.—Shell of medium size, transverse, equivalve, ellipsoidal in outline, with subterminal beaks. Hinge line apparently edentulous, straight, flattened and elevated posteriorly, terminating one fourth the length of the shell from the posterior extremity, at which point is the greatest height of the shell. Posterior extremity a semi-ellipse; anterior subtruncate above, regularly rounded below; a sinus in the ventral border one-third the shell-length from the anterior end, from which a diminishing furrow extends to the flattish, straight, incurved beak. Greatest thickness of shell on the middle line a little nearest to the anterior end. Surface marked by about three remote, deep, concentric grooves, and numerous fine lines of growth.

Length 1.2 (100); greatest height ·63 (52); thickness ·36 (30); projection of anterior end beyond the beak ·09 (7).

Locality.—Marshall.

This species seems to be destitute of the elongated posterior escutcheon characteristic of McCoy's *Sanguinolites*, but agrees perfectly with Professor King's modified ideas of *Allorisma*, (Perm. Foss. pp. 162 and 196). Some hesitancy is shown, however, among palæontologists about the adoption of the latter name, which McCoy regards as a synonym of *Sanguinolites*.

Sanguinolites borealis, n. sp.—Shell rather small, ventricose, transversely elliptic; beak somewhat projecting and incurved, less than one fifth the shell-length from the anterior extremity, with a lunuliform excavation in front of it; dorsal margin straight; ventral margin slightly arcuate; posterior extremity regularly rounded; anterior sharply bent in front of the lunule, from which it slopes with a truncate backward curve to the ventral border; umbonal slope extending diagonally to the infero-posterior margin, somewhat angulated behind the beak, and inflected toward the cardinal region. Surface of shell of northern specimens unknown; cast showing several distinct concentric grooves. Shell of southern specimens thin, marked both with concentric and minute radiating striæ. Greatest height of shell along the perpendicular from the beak; greatest convexity in the middle of the same line.

Length 1·10 (100); breadth ·44 (40); thickness of right valve ·15 (44).

Locality.—Grindstone quarries, Pt. aux Barques above the gritstones, and Moscow, Hillsdale county.

Distinguished from *S. unioniformis* and *S. Marshallensis* by its terminal beaks, greater relative gibbosity, greater length and its posterior attenuation.

Leptodomus, McCoy.

Leptodomus clavatus, n. sp.—Shell small, tumid, transversely quadrangular, obliquely carinate, concentrically sulcate, with subterminal beaks. Length nearly three times the breadth; ends abruptly rounded, and slightly deflected upwards, creating a discernible concavity along the extended hinge line. Beak (of left valve) broad, flattened, incurved, with anterior and posterior lunettes. Anterior extremity truncate along the anterior umbonal slope; posterior extremity squarely truncated; postumbonal slope diagonally precipitous to the cardinal expansion, which begins behind the beak and widens to the posterior extremity.

Length ·62 (100); height ·24 (39); convexity of left valve ·10 (16).

Locality.—Union, Branch county, in blue argillaceous shales of the Huron group.

This fossil may be a *Grammysia*, but it is destitute of the oblique furrows considered characteristic of that genus.

It bears a remote resemblance to *Sanguinolites* (*Leptodomus*) *costellatus*, McCoy.

CARDIOMORPHA, de Koninck.

CARDIOMORPHA MODIOLARIS, n. sp.—Shell rather small, vertically ovate, inflated, equivalve, with very short hinge line, and very symmetrical extremities. Hinge line blending by a regular curvature with the posterior margin; both margins approximately parallel, gradually curved, and connected by the more rapidly curved respiratory border. Beaks scarcely projecting beyond the hinge, obtusely pointed and straight; valve inflated and convex to the pallial border, slightly flattened on the anterior umbonal slope. Surface smooth, with a few coarse concentric folds marking the later growth.

Length from the extremity of the beak over the umbonal slope 1·05 (100); shortest distance from this line to extremity of anterior margin ·34 (32); to posterior margin ·40 (38).

Localities.—Section 27, Columbia, Jackson county; Moscow, Hillsdale county, and Marshall and Battle Creek, Calhoun county.

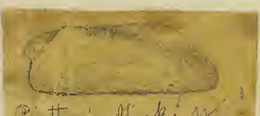
The hinge characters of this species not being known, its generic identity may be questioned. The beak and hinge line do not present the characters of the typical *Cardiomorpha*, but the shell presents strong analogies with *C. livida*, de Kon., (Anim. Foss. 106, pl. iii., 4), from which it differs only in being more equilateral and in having its beaks more separated.

CARDIOMORPHA JULIA, n. sp.—Shell small, luciniform; beaks moderately produced, small, appressed turned forward, somewhat anterior to the middle of the shell; posterior hinge slope nearly straight, making a very obtuse angle with the posterior margin, which is also nearly straight, and connects by an abrupt curve with the ventral border. Anterior hinge slope making an angle of about 118° with the posterior, uniting by an abrupt curve with the regularly convex ventral border. The hinge has not been fully examined, but a couple of fine sharp laminæ are seen proceeding from beneath the beak, along the posterior hinge plate. External surface marked by sharply cut concentric striæ, at regular intervals, which increase gradually in width with the growth of the shell.

Length from anterior to posterior angulation ·85 (100); height from beak to ventral margin ·64 (75); radius of curvature of ventral side ·48 (56); bringing the centre of curvature on the postumbonal slope ·17 from the beak; convexity of right valve ·12 (14); number of concentric striæ on the measured specimens about 45.

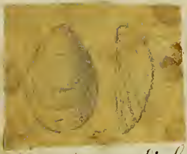
Localities.—Battle Creek, Marshall, Moscow. This seems to be a close representative of *C. Puzosiana*, de Kon. (Anim. Foss. 104, pl. ii., 8), and only differs in more angulated extremities and more regular striation; though an occasional specimen has more rounded extremities. This species recalls also the forms figured by Prof. Hall, under the names *Lucina? retusa* and *Ungulina* [*Lucina?*] *suborbicularis*, (Geol. Rep. 4th Dist., N. Y., pp. 243, 245), from the Portage group. While the Michigan fossil is more transverse than the specimens figured by Prof. Hall, it may yet prove identical.

CARDIOMORPHA CAPULOIDES, n. sp.—Shell very small, with a very prominent umbo; body and margin of each valve trumpet shaped, giving it the appearance of a capuloid shell. Beak slightly anterior, turned forward, and in the cast obtuse, with a terminal callosity, as if by the absorption of the shell-substance separating the extremity of an enrolled beak from the body of the mollusc. Body of shell more extended posteriorly; antumbonal slope rather rapid; margin nearly circular or a little ovate. Hinge and external surface unknown; cast smooth, with a few concentric wrinkles of growth.

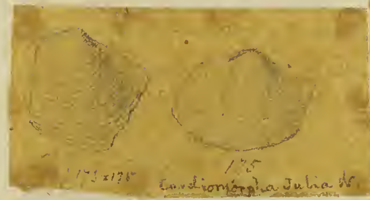


Prothyris Meeki, Win. M.S.

Prof. Winchell has figured this shell from the very base of his Marshall Group, and named it in M.S. P. Meeki. It also occurs in the Waverly sand-stone of Ohio



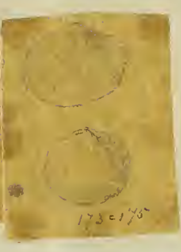
Cardium. modiolaris, W.



173 x 175

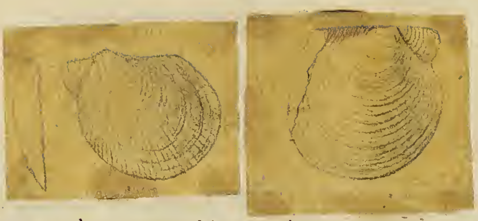
175

Cardiomorpha Julia W.



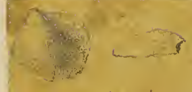
173 = 175

All figured by Prof. Winchell, and marked C. Julia. I should scarcely think these for no Cardiomorpha.

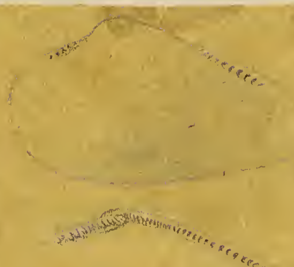


Right and left valve. Copied from Winchells drawings.

Pterinea crenistria Win.
= Cardiopsis crenistria, Win.

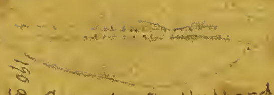


Cardiopsis jejuna W.



Ctenodonta Hubbardi. 4/1.

Prof. Winchell places this species under Ctenodonta, on page 128.



Ctenodonta Hubbardi

Length from extremity of beak over umbo to ventral margin ·35 ; antero-posterior dimension ·29 ; elevation of umbo above plane of valve ·20.

Locality.—Grindstone quarries, Pt. aux Barques, with *Rhynchonella camerifera*, &c.

None of my specimens of this singular shell are perfect, even as casts ; and I should be induced to refer them to *Platyceras*, Conrad, were it not that five would thus be sinistral and six dextral, while at the same time the very campanulate aperture seems to suggest rather *Cardiomorpha* or *Isocardia*.

Pterinea

CARDIOPSIS, Meek and Worthen.

CARDIOPSIS CRENISTRIATA, n. sp.—Shell of medium size, gibbous ; hinge line straight, rather short, joining the posterior margin by a regular curve which proceeds to the ventral side where a more abrupt curvature separates the posterior from the anterior border. Beak prominent, incurved, projecting a little above the hinge line. Surface marked by a set of irregular concentric wrinkles, and a set of fine, regular raised concentric striæ, the whole decussated by conspicuous, radiating, unequal, wrinkled ribs, which are fine and somewhat regular on the beak, becoming irregularly crenulated in the middle of the valve, and irregularly flexuous near the pallial border.

See p. 121

Greatest length from the beak to the ventral margin over the umbonal slope ·96 (100) ; angle between this and the hinge margin 55° ; convexity of left valve ·33 (34).

Locality.—Section 27, Columbia, Jackson county.

This fossil differs from *Cardiomorpha radiata*, de Kon., (An. Foss. 109, pl. ii., 6), in being less inflated all around the pallial region, and in being more produced posteriorly, as well as in the characters of the striation. It probably agrees in generic characters. Its closest analogue is *Cardiopsis radiata*, Meek and Worthen, (Proc. Acad. Nat. Sci., Phil., Oct., 1860, and June, 1861), = *Megambonia Lyoni*, Hall, (13th Rep. Reg. N. Y., p. 110), from which it seems to differ only in its striation.

CARDIOPSIS JEJUNA, n. sp.—Shell small, somewhat orbicular, nearly equilateral, with a prominent sharp beak slightly turned forward. Hinge line obtusely angulated beneath the beak, extending on each side to a subalate expansion of the (right) valve, between which points the curvature of the pallial margin decribes about three-fifths of a circle. Beak projecting above the hinge ; umbo excavated on the anterior side ; umbonal ridge tumid on the posterior side. Characters of hinge and external surface unknown ; surface of cast with a few concentric furrows.

Length ·38 (100) ; height ·41 (108) ; distance from posterior extremity to line drawn over umbonal slope ·23 (61) ; from anterior extremity to same line ·20 (53) ; convexity of right valve ·12 (32).

Locality.—Railroad cut, three miles north of Napoleon, Jackson county.

CARDIOPSIS MEGAMBONATA, n. sp.—Shell very small, ovate, with an elevated, little incurved, nearly central beak, gibbous umbo and regularly rounded margins, of which the ventral is most abruptly so. Slopes from the umbo convex in all directions to the very margin. Anterior and posterior cardinal margins similar and equal. Surface of casts striately ribbed, most distinctly so toward the ventral border, and in some cases marked by rather strong concentric wrinkles toward the pallial margin.

Height from beak to ventral margin ·25 (100) ; length from anterior to posterior margin ·23 (92) ; convexity of left (?) valve ·11 (44).

Locality.—Grindstone quarries, Pt. aux Barques, with *Rhynchonella camerifera*, &c.

Ctenodonta

NUCULA, Lamarck.

NUCULA HUBBARDI, n. sp.—Shell rather large, ovate-triangular, ventricose ; beaks three-fifths the shell-length behind the anterior (longer) extremity, prominent, acute, incurved and turned backward; cardinal lines nearly straight, beyond the dental series curving rapidly to the extremities, of which the anterior is broadly rounded; ventral side with a slight general convexity, varied by a broad shallow sinuation in front of the middle, which extends one-third the distance up to the beaks. Pallial line entire; posterior adductor forming a round deep scar. Cardinal angle between the beaks varying from 115° to 125°; teeth numerous, in a series not perceptibly interrupted between the beaks, those on the anterior slope posteriorly angulated, those on the posterior slope rather larger; the remoter often transverse to the hinge plate; those nearer the beak angulated forwards; between the beaks the hinge plate is somewhat widened, and the teeth are slender, long and crowded in a scarcely interrupted series. Shell massive, thickened around the smooth ventral margin; external surface marked by numerous unequal lines of growth; casts nearly smooth.

Length of an average specimen 1·45 (100); height ·80 (55); convexity of one valve ·26 (18); length of posterior end ·59 (41); anterior end ·96 (66); height of beaks above line connecting extremities ·46 (32); number of teeth in posterior series from 12 to 16; in anterior from 30 to 40.

Localities.—Marshall, Battle Creek, Moscow, and at nearly every other exposure of the Marshall Sandstone in the southern part of the State. The most abundant fossil in the group, generally occurring in beds ten or twelve inches in thickness.

This species has about the proportions of *Cucullella tenuiarata*, Sandb. (Verstein, 276, Taf. xxix. 4), but specimens of the latter from Kirschweiler, in the cabinet of Dr. Rominger, are more symmetrically furrowed, and possess fewer teeth.

This is, perhaps, the species described by Dr. Stevens as *Leda nuculæformis* (Sill. Jour. [2], xxv. 262), but it is not *Leda*, and the number of teeth is much too great for his description.

Named in honor of Bela Hubbard, Esq., of Detroit, who published in 1840 the first notice on record of the interesting sandstones under consideration, and designated the generic relations of several of the more abundant fossils.

Var. *prolata*. A form which I am inclined to regard as only a variety of the preceding, is very ventricose, and more elongated anteriorly, with a greater number of teeth.

Length 1·46 (100); height ·69 (47); convexity of one valve ·28 (19); length of posterior end ·38 (26); of anterior end 1·06 (72).

Localities.—Moscow and Battle Creek.

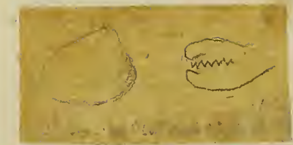
NUCULA IOWENSIS. White and Whitfield (Proc. Bos. Soc. Nat. Hist., Feb. 1862, p. 298).—Shell small, triangularly ovate, ventricose, with prominent incurved, subterminal beaks. Cardinal plate forming an angle of 95°, but the dorsal outline of the shell, from the prominence of the beaks, forms an angle of 80°. Anterior and posterior slopes truncated; anterior extremity rounded, ventral border semi-elliptic. Long end with about 11 teeth; short end with 6 very inconspicuous ones. Pallial impression entire, connecting the deep adductor scars; anterior scar nearly terminal, lenticular, with a small oval scar above; posterior scar oval, scarcely above the extremity. Shell thickened near the margin.

Length ·47 (100); height ·40 (85); convexity ·26 (55); distance from beak to line joining extremities ·27 (57).

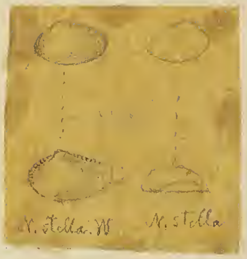
Localities.—Battle Creek and Sec. 7, Wyoming, Kent county.

These specimens possess a somewhat greater number of teeth than the Iowa ones, according to the author's description. In general form they recall *Cucullæa antiqua*, Sow., from the old red sandstone of Felindre (Murch. Sil. Syst., pl. iii. fig. 120).

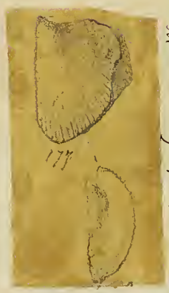
NUCULA SECTORALIS, n. sp.—Shell rather small, ventricose, sectoriform, with nearly central beaks. Anterior cardinal slope straight; posterior, nearly so,



Nucula Iowensis, White & Whitf. From Winchell's drawing.



Winchell refers it to Ctenodonta,
(see p. 129



Con. Napoleonense W.

making with the former an angle of 88° to 91°; ventral border sub-circular. Beaks prominent, acute, direct, incurved. Anterior hinge plate with about 17 teeth; posterior with about 13, much smaller. Adductor scars subterminal, profound, roundly oval. Surface of casts perfectly smooth.

Length ·86 (100); height ·74 (86); thickness ·44 (51); distance form beak to line joining extremities ·40 (46); length of anterior end ·51 (59); of posterior end ·35 (41).

Locality.—Battle Creek and Grindstone Quarries, Pt. aux Barques.

Nucula Stella, n. sp.—Shell very small, elliptic-ovate, with subcentral beaks. Anterior cardinal slope arched, posterior nearly straight; extremities rather sharply rounded; ventral side semi-elliptic. Anterior hinge plate with 17 minute, acute teeth; posterior with 5, angulated in both cases towards the beak. Beaks a little attenuated near the extremity, curved inwards and backwards. Pallial line entire, connecting the muscular scars, which are oval, and situated considerably above the middle line of the shell. Shell thin, with delicate concentric striæ.

Length ·33 (100); height ·24 (73); thickness ·14 (42); length of anterior end ·20 (61); of posterior end ·13 (39); distance from beak to line adjoining extremities ·14 (42).

Localities.—At every outcrop of the formation in the southern part of the State. Also at the Grindstone Quarries, Pt. aux Barques.

This beautiful little shell has affinities with *N. ventricosa*, Hall, (Iowa Rep. 716, pl. 29, fig. 4), from the coal measures of Iowa. It is easily mistaken for the young of *N. Hubbardi*, but is proved distinct by its more rounded sides and fewer teeth, as well as by its occurrence in a region of the State where the larger species is as yet unknown.

Leda, Schumacher.

Leda bellistriata, Stevens (Sill. Jour. [2], vol. xxv., p. 261).—Shell small, twice as long as high, somewhat ventricose, with sub-central beaks, which are rather prominent, incurved and pointed forward. Anterior cardinal slope slightly convex, posterior concave, with a well defined, long, deep and narrow escutcheon; anterior extremity broadly rounded; posterior attenuate, with a blunt termination. Angle of the cardinal line between the beaks 130°. Surface marked by regular sharply-impressed concentric striæ, of which 45 may be counted between the ventral margin and a point one-tenth of an inch below the beak, where they become undistinguishable. Striæ not visibly extending across the escutcheon.

Length ·61 (100); height ·34 (56); thickness ·18 (29); length of posterior end ·38 (62); of anterior end ·23 (38); height of beaks above line connecting extremities ·17 (28).

Locality.—Moscow, Hillsdale county.

I see no means of separating our species from the one described by Stevens from the coal measures of Ohio. Prof. Hall's specimens from Iowa, however, which he has referred to the same species, differ from ours in a broad escutcheon, and the continuation of the striæ across it, characters which are stated *not* to exist in the original specimen.

A rostral extremity of a *Leda*, from Battle Creek, marked and proportioned as above, is ·64 long and ·59 high, and by the principles of proportion must have belonged to an individual nearly 1½ inches long.

Cardium, Bruguière.

Cardium Napoleonense, n. sp.—Shell small, truncately triangular, oblique. Beaks elevated above the hinge, prominent, sharp, direct; hinge-line anterior to beak, short and straight, forming a rounded anterior angle with the ventral border, which sweeps by a regular course to the posterior border, which is elongate, truncate at right angles with the hinge-line, and furnished with a large arched opening beneath the umbo. This truncation makes but a small angle with the midumbonal slope, the arch beneath which is partly closed by the curtain-like deflection of the posterior part of the shell. External surface marked by fine radiating ribs, and a few concentric rugæ in front of the beak and along the anterior terminal expansion.

Height of shell from beak along midumbonal slope to remotest point of ventral border ·59 (100); distance from anterior cardinal angle across the shell at right angles with posterior truncation ·42 (71); convexity of right valve ·15 (25).

Localities.—Marshall, Battle Creek, and R. R. Cut, 3 miles North of Napoleon, Jackson county.

CONOCARDIUM, Bronn.

CONOCARDIUM? BOVIPEDALE, n. sp.—Shell small, very ventricose, truncated along the umbonal slope, or a little posterior thereto, by a plane nearly vertical to the plane of the valves, but a little inclined posteriorly, thus producing a slightly acute plane angle with the external surface. Beak prominent, somewhat enrolled and turned forward; hinge-line anterior, short, convex, joining, by a rounded, obtuse angle, the gently rounded anterior angle, which curves more rapidly in approaching the ventral margin and the truncation. Posterior, truncated side nearly flat, but a little concave, with an arched, mactra-shaped opening under the umbo. Convex surface of shell, with 26 radiating ribs, slightly flattened along their summits, and very fine, sharp, undulating, concentric striæ, most distinct between the anterior angle and the umbo; the truncated surface with obsolete arched striæ. Right valve unknown.

Length along truncating line ·30 (100); distance from anterior extremity to truncating plane, at right angles with latter ·20 (67); convexity of left valve ·12 (40).

Locality.—Marshall.

This species belongs to the group of *C. Napoleonense*, but may be easily distinguished by its coarser ribs, greater ventricosity, less flattened marginal regions and nearly mesial truncation.

POSIDONOMYA, Brown.

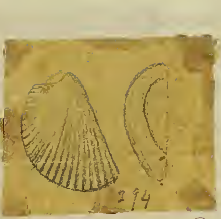
POSIDONOMYA ROMINGERI, n. sp.—Shell of medium size; general outline about two-thirds of an ellipse, the longer axis of which is nearly at right angles with the anterior cardinal slope of the shell, and forms an angle of 75° with the straight hinge-line, and one of 33° with the midumbonal slope; greatest width of shell a little nearer the (regularly curved) ventral border; region behind the beak a little excavated, making the posterior cardinal region appear slightly flattened and produced; beaks elevated above the hinge-line, approximated and slightly turned forward. Surface (of cast) distinctly marked by continuous equidistant and direct concentric striæ. Hinge unknown.

Greatest length of shell (over midumbonal slope) ·97 (100); longer axis of the elliptic outline ·90 (92); greatest width of shell (at right angles with last measure ·70 (72); thickness of right valve ·20 (21); number of striæ in one-tenth of an inch, in the middle of the shell $3\frac{1}{4}$.

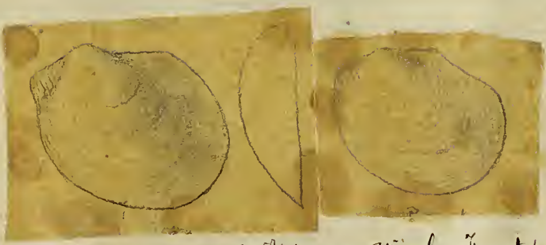
Locality.—Marshall.

Closely imitates in outline *P. vetusta*, Sow. sp. (Phill. Geol. Yorks. 211, pl. vi. 3), but the beak is less projecting, and the concentric furrows are more numerous and smaller.

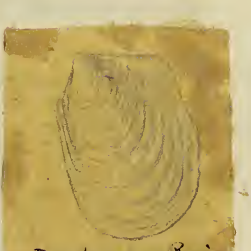
POSIDONOMYA WHITEANA, n. sp.—Shell of moderate size, oblique, with an extended, straight, hinge-line, a subalate expansion before, and a rather flattened and extended posterior margin. Beaks little elevated above the hinge, incurved, and slightly turned forward. Umbonal ridge much swollen, situated anterior to the middle of the shell, and making an angle of 66° with the



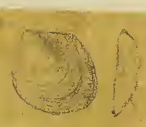
Conocard.? bovipedale, W.
from orig. drawing



Posidonomya Whiteana, Winch. From type

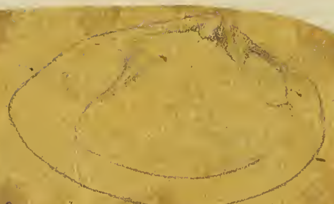


Posidonomya Romingeri, Winch



Posidonomia mesombonata, W.

Does not even belong to the same family as Sanguinolaria



Sanguinolaria similis W.

This and the other species on the leaf opposite p. 129. Seem to me to belong to *Carbonicola* or some allied group of the *Crassatellidae*. They *certainly* do not belong to *Sanguinolaria*.

straight hinge-line. Surface of cast nearly smooth; pallial line distinct, entire. Surface of shell showing only five irregular lines of growth, without undulations.

Length over umbonal slope ·64 (100); diameter at right angles with this dimension ·50 (77); convexity of left valve ·15 (23).

Locality.—Marshall.

Named in honor of C. A. White, M. D., of Burlington, Iowa.

Posidonomya mesambonata, n. sp.—Shell small, tumid equimarginal. Beaks prominent, slightly incurved; umbonal slope passing scarcely anterior to the middle of the valve, and nearly at right angles with the short, straight hinge-line; posterior margin slightly curved, scarcely alate, obtusely angulated at its junction with the dorsal side; anterior margin similar to posterior, and connected with it by the semi-circular ventral margin. Entire surface convex, without undulations, and marked only by fine striæ of growth.

Length from beak to opposite ventral margin over umbo ·50 (100); width at right angles with this line across the middle (and widest part) of the valve ·41 (82); convexity of right valve ·12 (24).

Localities.—Marshall and Moscow.

Almost an exact copy in outline of *P. vetusta*, Sow. (de Kon. Anim. Foss., pl. vi. fig. 1, *a* and *b*, not *c*.) It wants, however, the undulations of that species, and is smaller.

Sanguinolaria, McCoy.

Sanguinolaria similis, n. sp.—Shell rather large, transversely elliptic, rather appressed. Beaks a little anterior to the middle of the shell, flat, obtuse, and little elevated. Hinge-line about one-third the length of the shell, slightly angulated under the beaks; buccal and anal slopes somewhat straight; anterior and posterior margins abruptly rounded; ventral margin regularly curved, except a slight bend in the middle. Longest dimension equidistant between beaks and venter. Pallial impression entire?; anterior muscular scar roundish-oval; posterior obliquely pyriform. A pair of strong internal ridges diverge from beneath the beaks (as in Tellina), the anterior passing along the posterior side of the buccal scar, and the posterior along the front margin of the posterior scar, terminating opposite the lower borders of the respective scars. A sharp but shallow groove runs along the anterior of the posterior ridge. Hinge not fully known; a strong triangular cardinal tooth passes a little obliquely forward across the hinge-plate, behind which is a deep pit, while a shallow one bounds the tooth anteriorly; an elongated triangular lateral tooth extends in front of the beak, and apparently another behind the beak. Shell thick; external surface marked by irregular, fine incremental striæ, and a few broad shallow furrows.

Length 2·0 (100); height 1·11 (55); convexity of one valve ·23 (11); length of posterior lateral tooth ·42 (21); from beak to anterior extremity ·95 (47); to posterior extremity 1·25 (62).

Locality.—Marshall, where it is rather abundant.

Sanguinolaria septentrionalis, n. sp.—Shell of moderate size, equivalve, quadrately elliptic, subtumid, with sub-central beaks. Hinge line occupying three-fourths the length of the shell, nearly straight. Posterior extremity roundly truncate by a plane inclining towards the beaks; anterior end similarly truncated by a plane parallel with the last; ventral border slightly arcuated, bounded behind by a rounded acute angle, and before by a rounded obtuse angle. Hinge (as shown by casts) consisting of a prominent triangular cardinal tooth, and a lateral one each side—the posterior very slender. Pallial line entire (?); anterior muscular scar small, nearly circular. Clavicular ridges indistinct. Surface of casts showing a few obscure incremental furrows.

Length 1·15 (100); height ·73 (63); convexity of left valve ·15 (13).

Locality.—Gaines, Kent county, from large angular fragments of a purplish-red, friable sandstone, strewn along the region of outcrop of the Marshall sandstone throughout the western part of the State.

Sanguinolaria sectoralis, n. sp.—Shell rather large, subtumid, triangular, with beaks but little in advance of the middle. Anterior and posterior cardinal slopes but slightly curved, the latter the longest; anterior end a broad curve; posterior more produced and more abruptly curved between the extremities. Beak prominent, somewhat depressed, incurved. Greatest thickness of shell in the middle. Muscular pits situated above the middle, oval, profound, connected by the entire pallial impression.

Length 1·18 (100); height ·92 (78); thickness ·54 (45); length of anterior end ·43 (36); of posterior end ·75 (63). Length, height and thickness of largest specimen seen are 1·75 (100), 1·30 (74) and ·70 (40); length of anterior end ·80 (45); of posterior end ·94 (53).

Locality.—Marshall.

Solen, Linnæus.

Solen scalpriformis, n. sp.—Shell of moderate size, having the hinge line straight, and the ventral regularly curved, and so situated that its chord forms posteriorly, an angle of about 5° with the dorsal margin; extremities abruptly rounded—the anterior one regularly, the posterior truncately. Valves with a slight constriction beneath the subterminal beaks, which corresponds to a strong ridge within, fading away at about half the distance from the dorsal to the ventral margin. Valves but moderately inflated, flatter behind, and a little drawn together anteriorly. Exterior surface marked by incremental lines nearly concentric with the pallial border.

Length of shell 2·05 (100); projection of anterior extremity beyond the beaks ·11 (5); greatest width of shell (one-third its length from forward end) ·56 (27); width at two-thirds the shell-length from forward end ·48 (23), whence it narrows rapidly.

Localities.—Marshall and Moscow, abundantly. Also, near Napoleon.

A well marked variation in form has been observed in many specimens, having a straight ventral border and more uniform width.

Solen quadrangularis, n. sp.—Shell of medium size, quadrangular; hinge margin straight, somewhat shorter than the ventral margin, which is also straight through the greater part of its length, but is abruptly rounded upwards anteriorly, and a little more gradually rounded posteriorly. Beaks terminal; anterior extremity of shell transversely truncate, posterior obliquely so. Valves rather tumid anteriorly, becoming less so posteriorly; not at all contracted toward the gaping extremities. A constriction appears close to the anterior extremity, which corresponds to a ridge within, narrow and sharp near the beak, but becoming broad and depressed towards the opposite margin. Surface marked by distinct lines of growth running parallel with the ventral and posterior margins.

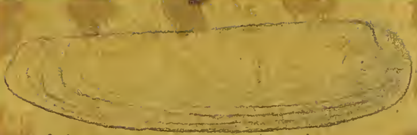
Greatest length 2·0 (100); width ·66 (33); posterior truncation forming with hinge-line an angle of about 64°.

Locality.—Marshall.

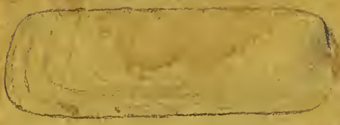
Solen priscus, n. sp.—Shell of medium size, slightly arcuate by an inflection of the two extremities toward the ventral side; dorsal and ventral margins nearly parallel; valves but little inflated, giving an oval-lanceolate transverse section; anterior extremity widely gaping, projecting a little beyond the beak, regularly rounded to the ventral side below, and above truncated obliquely backwards to the vicinity of the hinge; posterior extremity obliquely truncate, with the lower angle abruptly rounded. The cast shows the impression of a broad ridge passing from the hinge toward the ventral margin, and is further marked by distinct incremental lines parallel with the pallial border except on the anterior truncation, by which they are intercepted.

Genus Solenopsis. M'Coy 1844.

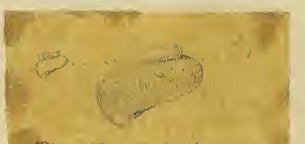
Winchell also identified this from Tennessee (see p. 256).



Solen scalpriformis Vr.

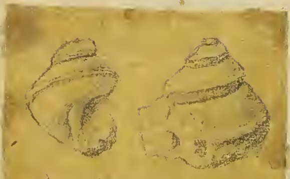


Solen quadrangularis Vr.



Pleurot. Marshallensis, W.

copied from Prof. Winchells drawings marked as above; but I have not been able to find his description.



Pleurot. Whitei, Win.

From Prof. W's drawings

Length about 2·75 (100); width ·78 (28); thickness ·25 (9); projection of anterior extremity beyond beaks ·28 (11); posterior angle formed with hinge line by anterior truncation 140°; anterior angle formed by posterior truncation 128°.

Locality.—Union, Branch county, in blue argillaceous shales of the Huron group—the "Kidney Iron formation" of Houghton.

But few specimens of this interesting species have been seen, and the best of these is defective at the posterior extremity; and I have determined the total length only from a restoration founded on the incremental lines.

The three foregoing species of *Solen* nearly double the number previously known from the Palæozoic rocks. Messrs. Sandberger have described *S. costatus* from the *Aviculaschiefer* of the Spiriferensandstein group in Nassau, which is supposed by them to occupy the horizon of the Marcellus Shale and Hamilton group. *S. pelagicus*, Goldf., and *S. Lustheidi*, d'Arch. and Vern., come also from the Devonian, but they are both doubtful species. The first is referred by d'Orbigny to *Cypricardia;* the latter, judging from specimens in Dr. Rominger's collection from the Eifel, has the valves scarcely gaping anteriorly, and presents much the appearance of a *Solemya*, (see especially *Solemya primæva*, Phil. McCoy, Brit. Pal. Foss. pl. 3F., fig. 3). Lastly, de Koninck has noticed a very imperfect solitary specimen, *S. siliquoides*, from the subcarboniferous limestone of Visé, in Belgium.

Pugiunculus, Barrande.

Pugiunculus (?) aculeatus, Hall, (13th Rep. N. Y. Reg., p. 107).—Shell small, elongate, tapering, with an obtusely triangular section. Slant height slightly curved on all the sides and angles; sides also more convex in the transverse direction. The two equal sides making with each other an angle of 102°, and with the broader side angles of 39°. Specimen a cast without any external markings.

Length ·43 (100); breadth of sides at aperture ·19 (44), ·12 (28), ·12 (28).

Locality.—S. E. ½ S. W. ¼ Sec. 23., Adams, Hillsdale county.

This form lacks the evidence of striation attributed to *Pugiunculus*, Barrande (*Theca* of English authors) and presents still less agreement with any other known genus. The original specimens were described from Rockford, Indiana.

Pleurotomaria, Defrance.

Pleurotomaria vadosa, Hall, 10th Rep. N. Y. Reg., p. 108).—Shell globosely conical, with a width equal to its height; whorls about three, rounded on the exterior, somewhat flattened where they come in contact, marked along the middle by a moderately raised carina, on each side of which is a feeble but distinct revolving line, and beyond this another still feebler, and sometimes a third; body whorl occupying about three-fourths of the altitude of the shell, regularly curved on the base, and limited by a neatly rounded umbilicus open to the apex of the shell. Aperture subcircular, but slightly modified by the body whorl; apex quite obtuse; angle of sides 65°; sutural angle about 90° on the last whorl. Cast shows the revolving lines on the last whorl, but not on the preceding ones.

Height of shell ·44 (100); width ·48 (109); height of body whorl ·36 (82); diameter of umbilicus (in a cast) ·08.

Locality.—In a loose fragment from the western part of the State, consisting of an agglomerated, silicious, sintery and somewhat ferruginous mass of fossils, physically resembling some states of the Marshall sandstone. Described here in consequence of its supposed identity with a fossil from beds which appear to be the equivalent of the Marshall sandstone, at Rockford, Ind.

Pleurotomaria Whitei, n. sp.—Shell with a trochoid spire, straight columellar lip, and prominent carinate whorls. Number of whorls three and a half, rapidly enlarging, raised in the middle of the dorsum in a prominent carina; the sides of which rise vertically from the whorl and form a feebly bilinear crest—a character best seen in specimens with the shell partly worn away; from the base of the carina the surfaces slope with but little curvature, at an angle of 115° to 120° with each other, and form a well marked sutural angle of about the same value with the contiguous whorl. Apex rather obtuse; angle of sides 67°. Aperture roundly quadrangular, produced on the columellar side. Umbilicus remote.

Height of shell ·64 (100); width of last whorl ·59 (92); height of last whorl 53 (83); width of aperture at right angles with columella ·29 (45); greatest width—at an angle of 45° with the columella—·42 (66).

Locality.—With *P. vadosa.*

Somewhat resembles *P. subconica* from the Trenton limestone, but the whorls are not so closely crowded—being thus more rounded, and forming a much deeper suture.

Named in honor of Mr. A. D. White, an efficient assistant in the geological survey of the State during 1859 and 1860.

Pleurotomaria humilis, n. sp.—Shell depressed, conical. Band prominent, revolving close to the linear suture in the upper whorls, central on the body whorl; surface of shell above and below the band but slightly convex on the body whorl, flat on the spire, and making a peripheral angle of 61°. Inclination of sides 109°. Umbilicus small, and apparently perforate.

Approximate measurements of an imperfect specimen: height ·52 (100); with ·67 (129); height of last whorl ·46 (88); width of umbilicus ·09.

Locality.—With *P. vadosa.*

Has the general form of *P. crenato-striata*, Sandb., (Verstein. Taf. xxii. 2), but the band is narrower and more prominent. It closely resembles *P. helicinoides*, McCoy, (Synop. Carb. Foss. Irel., pl. 7, f. 6), but is less depressed and formed of fewer whorls.

P. stella, W.

Pleurotomaria Stella, n. sp.—Shell minute, trochiform, composed of four and a half whorls closely appressed, and forming an apical angle of about 90°. Suture linear, inconspicuous—the flat sides of the whorls all lying in the same plane. Body whorl regularly rounded, marked by a raised bilinear band situated a little above the peripheral line, and on the whorls of the spire nearly concealed. The body whorl is ornamented by a line of minute tubercles running close to the suture, and occupying a feeble revolving ridge. No indications can be seen of transverse striæ connected with the tubercles. Aperture subcircular, with the columellar lip reflected over the umbilicus. Some sharp irregular incremental lines rise from the umbilical depression, and extend across the body of the shell.

Height ·16 (100); width ·20 (125); height of body whorl ·14 (88); height of aperture .09 (56); width of band at aperture ·02 (12); number of tubercles in one-tenth of an inch, 12.

Locality.—N. W. ¼, N. W. ¼, Sec. 4, Jefferson, Hillsdale county.

Pleurotomaria exigua, n. sp.—Shell very small, depressed-turbinate, consisting of three and a half rapidly enlarging convex whorls but slightly appressed and forming a deep suture, with an apical angle of about 87°. Base of shell convex, descending into a broad, deep umbilicus, from which rises a set of sharp transverse striæ crossing the whorl at right angles, but slightly bent backwards on reaching the band, which is broad and situated a little above the peripheral zone, and marked by incremental lines; above the band similar striæ describe an anteally convex curve to the suture. Aperture circular.

Height of shell ·17 (100); diameter ·18 (106); height of last whorl ·14 (82); width of band ·02 (12); number of transverse striæ in one-tenth of an inch counted near the aperture above the band is 24.

Locality.—N. W. ¼, N. W. ¼, Sec. 4, Jefferson, Hillsdale county.

PLEUROTOMARIA HURONENSIS, n. sp.—Shell rather large, depressed-turbinate, consisting of about four very rapidly enlarging whorls. Body whorl flattened from above, moderately convex above; the base a twisted plane bounded on one side by the slope into a large open umbilicus, on the other, by the sharp prominent carina which marks the periphery of the whorl. Surface of the whorl marked by eleven raised plications and intervening broad sulci, of which, counting from the umbilicus, the sixth rests upon the carina, and the eleventh is close to the suture. These are crossed by striæ of growth rising from the umbilicus, stretching far forward upon the base, curving backwards just before reaching the carina, and apparently curving forward again after passing it.

Height of shell 1·00 (100); diameter of base 2·00 (200); transverse diameter of aperture ·92 (92).

Locality.—Light-house, Pt. aux Barques, in intercalated sandstones of the Huron group.

This species recalls *Euomphalus carinatus*, Sow., (Murch. Sil. Syst., 616, pl. vi. fig. 10).

DENTALIUM, Linnæus.

DENTALIUM ? BARQUENSE, n. sp.—Shell small, very gradually tapering, slightly compressed. Surface of cast smooth. Surface of shell unknown—apparently striate or grooved transversely; shell-structure prismatic, the axes of the prisms being normal to the surface of the shell. The shortness of these prisms gives the structure the appearance of miniature mosaic. Diameter of fragment ·06.

Locality.—Pt. aux Barques, in a stratum overlying the gritstones.

BELLEROPHON, Montfort.

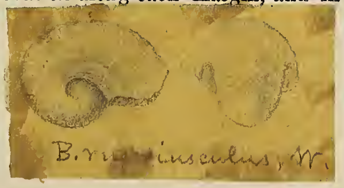
BELLEROPHON RUGOSIUSCULUS, n. sp.—Shell of moderate size, globoid, very rapidly enlarging; umbilicus rather broad and deep, but not perforate—only one whorl being exposed to view. Transverse section somewhat rhomboidal, with rounded angles, becoming more rounded with age. Keel in the young shell rather prominent, but obtuse, becoming more depressed with age, until finally the dorsal surface is regularly rounded, and the sides have developed some obliquely longitudinal folds winding into the umbilicus. Aperture transversely expanded, subreniform. The entire surface, except the peripheral belt, is marked by direct, longitudinal raised striæ, separated only by a narrow groove; these are crossed by a set of transverse striæ, which, on the umbilical slope are somewhat irregularly waved and more pronounced than on the dorsum; on passing the lateral angle they divide irregularly and result in a set of finer striæ, which are abruptly reflected in approaching the keel, and in the older portion of the shell, gradually disappear before reaching it, while in the young shell they meet upon the keel in an acute angle of about 58°. Cast nearly destitute of ornaments.

Diameter of large specimen ·77 (100); height of last whorl to the middle of the umbilicus ·52 (68); height of aperture ·36 (47); width of aperture ·54 (70); number of longitudinal striæ in one-tenth of an inch 8; number of transverse striæ in one-tenth of an inch, counted on the umbilical slope 6, counted on the keel 12 to 15.

Localities.—Marshall and Secs. 19 and 26, Liberty, Jackson county.

The general appearance of this shell is that of *B. decussatus*, Flem., but a careful examination of all the figures and descriptions in my possession, has convinced me that it is a distinct though representative species. Want of space, however, forbids offering the comparisons.

Var. *tæniatus.* This well-marked variety (perhaps distinct species) is the form which approaches nearest to Sandberger's *B. decussatus.* It differs from the usual forms of the present species in having a less depressed dorsum and a smaller transverse diameter; a more prominent keel which is bounded by a slight elevation along each margin, and in its finer striæ, especially on the



B. ru[illegible]iusculus, W.

From Winchell's drawings

umbilical slope. In a specimen which is ·6 (100) across the outer whorl, the height of the aperture is ·32 (53), its width ·38 (63). The number of longitudinal striæ in one-tenth of an inch is about 14, and the number of transverse striæ 18.

Locality.—Moscow, Hillsdale county.

retrally

Bellerophon galericulatus, n. sp.—Shell small, globose, involute, ecarinate, exumbilicate, longitudinally striate, and deeply notched. Dorsum broadly and regularly rounded, without any evidences of a band, except in approaching the aperture of adult shells, where a rather broad band with ~~ventrally~~ concave incremental lines can be faintly traced. Aperture crescentic, not suddenly expanded, strongly auriculate, with the ears hanging detached from the inner whorl. Notch infundibuliform, deep and broad, obtuse, its sides reaching to the tips of the auriculations. Umbilicus closed, scarcely indented. Dorsal and dorso-lateral surface marked by about 28 longitudinal, sharply raised striæ, separated by much wider flutings, and not perceptibly modified by the dorsal band until within half a whorl of the aperture of the adult shell, when the two middle striæ become slightly raised and enlarged, and the entire set simultaneously die away. Between these striæ and the umbilical point similar striæ diverge spirally and irregular until intercepted by the former set, or by each other. Cast smooth, perforately umbilicate.

Average diameter of adult ·47 (100); height of last whorl at the aperture ·26 (55); height of aperture ·18 (38); showing the inner whorl impressed into the outer ·08 (17); width of aperture ·35 (74); depth of notch ·22 (47); width of peripheral belt at notch ·06 (13); separating distance between tip of auriculations and inner whorl ·10 (21); number of striæ in one-tenth of an inch 10, and this is the same in young and old specimens. Diameter of largest specimen seen ·53.

Localities.—Marshall, Battle Creek, and nearly all other Southern outcrops of the Marshall Sandstone.

This shell bears a close resemblance to *B. Urei*, of authors, but seems to differ in essential points, as follows:—From *B. Urii*, de Kon. (An. Foss. 356, xxx. 4) in being only half the size, having the dorsal belt elevated instead of compressed, in its very deep notch, less proportional width and distinct auriculations; from McCoy's *B. Urei* (Brit. Pal. Foss., 554) in having the striæ much narrower than the intervening grooves and not at all modified by the dorsal band, and in having the width of the aperture less than the diameter of the shell. Prof. Phillips' figures differ in the absence of auriculations, and in the lateral striæ. To Fleming's original description I have not access.

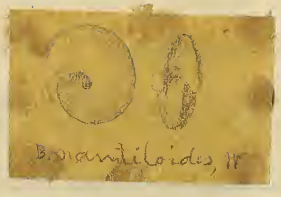
Bellerophon cyrtolites, Hall (13th Rep. N. Y. Reg., p. 107).—Shell subcuneiform, laterally somewhat appressed; whorls very rapidly enlarging, but slightly embracing; transverse section subcordate, broadest near the umbilicus; dorsum strongly but obtusely carinated; dorso-lateral slope nearly flat, sometimes slightly concave near the peripheral belt; sides regularly rounded, as well as the umbilical slope; umbilicus moderate, exposing only the last volution; notch deep, pointed, moderately broad. Entire surface of shell ornamented with fine, sharply raised tranverse striæ, which curve backwards upon the side, and meet upon the dorsum in an angle of about 60°. The umbilical region and the sides are equally marked by fine longitudinal striæ, which disappear in the vicinity of the keel.

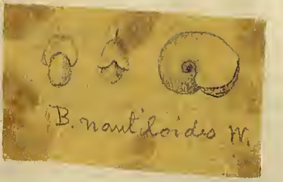
The largest specimen seen measures across the outer whorl ·41 (100); height of aperture ·23 (56); transverse diameter of aperture ·19 (46), with about 13 longitudinal and 13 transverse striæ in one-tenth of an inch, counted on the dorso-lateral slope near the aperture. Another specimen with shell better preserved has 10 transverse striæ in the same distance.

Locality.—Moscow, Hillsdale county.

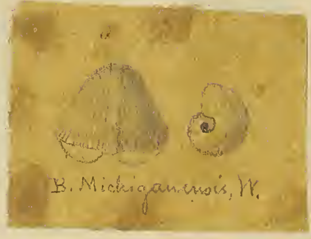
The side view and section of this species are not unlike those of *B. com-*

B. galericulatus W.


B. nautiloides, W.


B. nautiloides W.

From Winchell's drawings


B. Michiganensis, W.

From Winchell's drawings.

pressus, Sandb. (Verstein, Taf. xxii. 6.) = *B. striatus*, Sow. My specimens have the transverse section and external markings of the latter, but they are less capuliform (See Murch. Sil. Syst., 604, iii. 12e).

Bellerophon nautiloides, n. sp.—Shell involute, scarcely umbilicate, longitudinally striate and deeply notched. Dorsum regularly rounded, sometimes slightly raised along the peripheral band; sides less convex than the dorsum, bending into a small shallow umbilicus, not disclosing previous whorls. Aperture crescentic, width about equal to its height, strongly auriculate. Notch deep, but obtuse, broad, infundibuliform, with its margins reaching to the tips of the auriculations. Exterior surface longitudinally striate, with fine sharp raised lines marking the sides as well as the dorsum. Cast smooth, perforately umbilicate, exposing two whorls.

Diameter of large specimen ·50 (100); height of whorl at aperture ·31 (62); depth of impression of inner whorl into outer ·09 (18): height of aperture ·22 (44); width of aperture ·27 (54); separating distance between tip of auriculation and inner whorl ·10 (20); depth of notch ·17 (34).

Locality.—Moscow, Battle Creek, Marshall, and near Grandville, Kent county.

Bellerophon Michiganensis, n. sp.—Shell globose, carinate, involute, scarcely umbilicate, longitudinally and transversely striate. Dorsum obtusely angulated by the peripheral band, which is slightly raised, and more distinctly relieved by a furrow which runs along each margin. Dorso-lateral surfaces regularly convex, bending (in the cast) abruptly into a small perforate umbilicus. Aperture suddenly and widely expanded, broadly auriculate, and with a broad, rather shallow notch. Exterior of shell not seen; casts generally nearly smooth or faintly marked by longitudinal striæ, sometimes distinctly marked by two sets of striæ, the longitudinal consisting of 8 to 12 prominent raised lines on each side of the band, with one or two small intervening striæ, which gradually attain the size of the larger, these being crossed by finer, less regular transverse striæ, broadly curved anteriorly on the sides and suddenly bent backwards on the dorsum.

Diameter of last whorl (of cast) ·23 (100); height of aperture ·14 (61); diameter of aperture ·35 (152); diameter of whorl ·08 (35) back from the aperture ·25 (109); diameter of next inner whorl where it touches the lip ·17 (74); width of band close to aperture ·07 (30); depth of notch ·04 (17).

Localities.—Battle Creek, and the vicinity of Grandville, Kent county.

The characteristic of this species when compared with *B. galericulatus* is its great width in relation to its height, its much greater expansion of aperture, and its transverse striæ. The existence of a carina distinguishes it from *B. lineolatus*, Hall, from Rockford (13th Ann. Rep. Reg., N. Y., 107).

Bellerophon Barquensis, n. sp.—Shell small, globose, involute, rapidly enlarging, dorsally depressed; umbilicus small, but deep; dorsum broadly convex, with a distinct raised band; sides sharply rounded into the umbilicus; aperture crescentic, expanded, with a deep broad constriction behind it; notch deep and narrow. Surface marked by fine, regular, longitudinal lines, which cover the band as well as the other parts.

Diameter ·48 (100); transverse diameter of aperture ·54 (112); height of aperture to middle of umbilicus ·27 (56).

Locality.—Pt. aux Barques, above the gritstones.

Most nearly resembles *B. Michiganensis*, but the apertural construction and single set of striæ render it easily distinguishable.

Bellerophon lineolatus, Hall (13th Rep. N. Y. Reg., p. 107).—An imperfect specimen agreeing fully with Hall's description.

Locality.—Holland, Ottawa county.

Goniatites, de Haan.

Goniatites Romingeri, n. sp.—Shell of moderate size, globoid, exumbilicate.

Dorsum broad, regularly rounded; sides gently rounded with only a slight depression near the umbilical center. Septa approximate, thickened at the line of junction with the shell, producing furrows along the septum-lines of the cast. Lobes and saddles strongly pronounced. Dorsal lobe clavate linguiform, with a long cuspidate acumination reaching as far back as the preceding dorsal saddle; dorsal saddle linguiform, obtuse, unsymmetrical, indented on the dorsal side by the broadest part of the dorsal lobe, passing the point of the following lateral lobe; first lateral lobe profound, rather narrow, extending as far back as the dorsal, sublinguiform, acute; lateral saddle deep, very broad, somewhat regularly arched to the umbilical point, extending nearly as far forward as the dorsal saddle. Exterior unknown; surface of cast smooth.

Diameter of cast of last whorl ·84 (100); axial diameter ·38 (46); greatest transverse diameter of tube ·42 (50); distance from axial diameter to dorsum ·47 (56); length of dorsal lobe ·21 (25); of dorsal saddle ·19 (22); of lateral lobe ·20 (24).

Locality.—Marshall.

This well-marked species resembles *G. rotatorius*, de Kon. and *G. Ixion*, Hall, in the plan of its septa; but, besides its smaller size, its transverse diameter is proportionally much greater, being to the whorl diameter as 1 : 2 instead of 1 : 3; and the diameter through the points of the lateral lobes is as 1 : 2½, while in *G. rotatorius* it is as 1 : 4. The sides of the new species are also more convex.

Named in honor of its discoverer, Dr. C. Rominger, of Ann Arbor.

Goniatites Whitei, n. sp.—Shell very small, with surfaces regularly convex, a small deep umbilicus and sinuous apertural constrictions. Dorsum rather abruptly rounded, the curvature gradually diminishing on the sides, which are a little appressed; umbilical boundary rather sharply defined. Apertural constrictions separated about 80° from each other, forming a broad, shallow, ventral sinus across the dorsum, and a broader and shallower one on each side. Surface of shell faintly marked by lines parallel with the apertural constrictions, and in some cases by indications of fine crowded revolving striæ. Lobes and saddles strongly pronounced. Dorsal lobe truncately infundibuliform, minutely bi-denticulate, with the minute circular siphon issuing from between the denticulations; first lateral lobe acute, infundibuliform, separated from the dorsal by a deep parabolic saddle; second lateral lobe, which is separated from the first by a broadly parabolic saddle, is broadly infundibuliform, with its right angled apex resting on the brink of the umbilical pit.

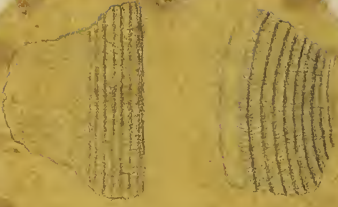
Diameter ·35 (100); thickness or transverse diameter ·21 (60).

Locality.—Union, Branch county, in blue argillaceous shales of the Huron group.

Named in honor of A. D. White, Esq., its discover.

Nautilus, Linnæus. Trematodiscus, Meek & Worthen.

Nautilus (Trematodiscus) strigatus, n. sp.—Shell of medium size; dorsum flattened, broad, equal to the greatest transverse diameter, bounded by a prominent angle on each side; lateral surface making a right angle with the dorsal, curving rapidly into the deep broad umbilicus; dorso-ventral diameter of shell equal to one-half the transverse. Surface marked by deep cut longitudinal flutings, of which about nine occupy the latero-umbilical region, and six, less remote, occupy the space on each side from the dorso-lateral angle half way to the middle line of the dorsum, thus leaving a middle belt along the dorsum equal to one-half its width, destitute of longitudinal grooves. The dorsal grooves nearer the midline become successively fainter, but the last one is well marked. In the bottom of each of these furrows are about three very fine longitudinal striæ. These two sets are crossed by fine, sharp, rather regular raised striæ, which curve gently backwards on the sides, while on the dorsal surface they are deflected, at first gradually, then very



Naut. striatus, Win

Orthoceras multicinctum Winchell. Copied from his drawing rapidly backward, forming along the middle belt a very deep, broad sinus. Septa regularly concave. Young shell less angular in transverse section.

Diameter of whorl (wholly septate) 2·4 (100); width of dorsum ·92 (39); dorso-ventral dimension ·53 (22); number of transverse striæ in one-tenth of an inch, counted on the dorso-lateral angle, about nine.

Locality.—Marshall.

The young shell of this species may be distinguished from the young of *N. striatulus*, from the same group, by the presence of the transverse striæ.

NAUTILUS (TREMATODISCUS) ALTIDORSALIS, n. sp.—Shell rather large; section quadrilateral, presenting an acute angle on the dorsum, a very obtuse one on the ventrum, and an angle of about 80° on each side, about two-thirds the distance from the dorsum to the ventrum; sides of section but slightly curved; middle line of dorsum not seen. Septa with shallow concavity, somewhat irregular—a shallow sinus occupying the lateral carina, and another the dorsal, with a slight forward swell on the dorso-lateral slope, and another in the umbilical cavity - a very unusual arrangement of the sinuses, since the forward sinuations are thus brought upon those points nearest the central line of the shell. Surface marked by about 8 broad longitudinal grooves on the umbilical slope, and a large number on the dorso-lateral. Each of these grooves contains about 18 very fine, wavy, raised striæ. Both sets are crossed by fine, somewhat irregular, transverse striæ, nearly direct, though slightly sinuated ventrally on the umbilical slope.

Diameter of (completed) whorl wholly septate 2·1 (100); dorso-ventral diameter of shell ·67 (32); transverse diameter ·78 (37); angle between plane of whorl and dorso-lateral slope 48°; between plane of whorl and umbilical slope ·55°; longitudinal grooves in one-tenth of an inch $1\frac{2}{3}$; longitudinal striæ in same distance 30; transverse striæ in same distance, counted on lateral carina, 8.

Locality.—Marshall.

This species, at first view, resembles *N. strigatus*, but is very distinct. Even small fragments may be distinguished by the numerous very fine striæ in the grooves.

ORTHOCERAS, Breynius.

ORTHOCERAS MULTICINCTUM, n. sp.—Shell small, very gradually tapering; section circular; siphon central (?); surface marked by numerous small, acute, transverse annuli, with intervening sharp grooves; septa with shallow convexity. Number of annuli in one-tenth of an inch 7.

Localities.—Marshall and Holland.

A close analogue of *O. cinctum*, de Kon. (An. Foss. 512, xliii. 6, xliv. 5, xlvii. 3), if it is not identical with it. The only perceptible distinction consists in its smaller size and more acute annuli and grooves. *O. cinctum* is said to occur in the Silurian, Devonian and Carboniferous systems. A species with such tenacity of life may have had a great geographical range.

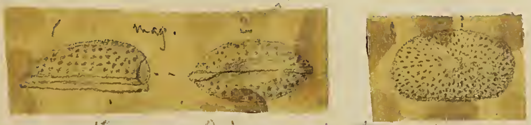
ORTHOCERAS GRACILIUS, n. sp.—Shell with an apical angle of $3\frac{1}{2}$°, a circular section and central siphon. Cast smooth; interseptal space ·04 where the diameter is ·9.

Locality.—Union, Branch county, in argillaceous shales of the Huron group.

CYTHERE, Müller.

CYTHERE CRASSIMARGINATA, n. sp.—Carapace minute, ventricose, regularly oval, microscopically wrinkled-scrobiculate; hinge-line impressed, and hinge-margin a little hollowed; valves margined by a smooth bead, which projects slightly beyond the general surface, behind which is a small groove; cast smooth, but margined by a raised band terminating near the hinge anteriorly and posteriorly.

Length ·08; breadth ·05.



Cyth. crassimarginata. Win.

1 Profile view of one
2. Dorsal view of the two
valves united
3 Side view } all mag
magnified.

Localities.—In the Marshall Sandstone, at Battle Creek, Liberty (Jackson county), Moscow, near Napoleon and at the Gritstone Quarries, at Pt. aux Barques, with *Rhynchonella camerifera.*

Besides the species already enumerated from the Marshall group there yet remain a few too imperfect for adequate description, or belonging to classes not yet investigated. Among these are *Lepidodendron* and *Neuropteris?;* a coralline structure, encrusting, foliaceous or branching, with minute, short, crowded polygonal cells ·0088 of an inch in diameter, without visible lamellæ, but with some indications of transverse floors; some undetermined Lamellibranchs; two sorts of Chiton-like scales; two or three Nautili, of which one is nodulous; and sundry remains of spines, teeth and bones of fishes.

University of Michigan, July 1, 1862.

F. B. Meek

Recd Ap. 10th 1863

PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF PHILADELPHIA.

1863.

January 6th.

Vice-President **Bridges** in the Chair.

Fifteen members present.

January 13th.

Mr. Jeanes in the Chair.

Eleven members present.

January 20th.

Vice-President **Vaux** in the Chair.

Eleven members present.

On motion, a vote of thanks was tendered to Mr. B. F. Saurman for a collection of mounted, native birds, presented by him this evening to the Academy.

January 27th.

The President, Mr. **Lea**, in the Chair.

Twenty-two members present.

On report of the Committee the following paper, read December 23d, 1862, was ordered to be published:

Descriptions of FOSSILS from the Yellow Sandstones lying beneath the "Burlington Limestone," at Burlington, Iowa.

BY ALEXANDER WINCHELL.

With the view of collecting facts bearing upon the determination of the geological age and equivalents of certain ferruginous sandstones in the lower peninsula of Michigan, which I have provisionally designated the Marshall Group,[*] I visited several of the neighboring States during the past summer, for the purpose of examining the principal exposures of strata supposed to occupy nearly the same horizon. At Burlington, Mr. C. A. White accompanied me in all my examinations, and enabled me to procure nearly a complete suite of the species of that place described by Shumard and Hall, but more especially by himself and Mr. R. P. Whitefield.[†] Besides the recognized species, I obtained from Mr. White, or by his assistance, several undescribed forms. Subsequently Mr. White greatly increased the number of unknown species by his discoveries at exposures hitherto but little explored. The whole collection of new species, together with his own observations thereon, has been kindly placed in my hands for investigation; and the following paper is the result of this study.

The number of new species herein described is fifty-nine, and the number now first identified, ten. The number of species previously known from these rocks was sixty-six,[‡]—a total which is now raised to one hundred and thirty-five.

The richness of this locality in fossil species is well worthy of note. To the one hundred and thirty-five species from the yellow sandstones must be added three hundred and seven species from the overlying Burlington limestone, making a grand total of four hundred and forty-two species from a single locality. It ought not to be forgotten, that this wonderful result has been developed mainly through the industry and skill of a single individual,—Charles A. White,—who, during eight years of his residence in the locality, has collected the types of two hundred new species and six new genera.

A consideration of the general conclusions deducible from the study of the palæontology of the rocks of the Western States supposed to occupy the horizon of the Marshall Group of Michigan will be hereafter presented. Suffice it to say, on the present occasion, that no one can glance over the list of species described here and elsewhere from these rocks without admitting that the *ensemble* bears a very close analogy with that of the "Mountain Limestone" of the Old World, and raising the inquiry *how* the equivalent of the old red sandstone can lie on the *top* of such an assemblage of strata.

Descriptions of New Species and Genera.

LEPTOPORA, n. gen.

Etymology, Λεπτος, *shallow* and πορα, *a cell.*

Corallum occurring in thin discoidal masses; cells very shallow, crowded, polygonal, separated by a common cell-wall, which is vertically striated; interior of cells filled with a finely vesicular tissue; cups polygonal, concave, elevated in the centre, and displaying numerous radial lamellæ.

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[*] See "First Biennial Report" of the Geological Survey of Michigan, 1860. For descriptions of the fossils of this group, see Silliman's Journal, [2,] vol. xxxiii. p. 352, and Proc. Acad. Nat. Sci. Phila., Sept., 1862, p. 405—430.

[†] For White's descriptions, see Jour. Bos. Soc. Nat. Hist., vol. vii., and Proceedings of same, vol. ix. p. 28, et seq. For White and Whitefield's descriptions, see "Proceedings," vol. viii. p. 289.

[‡] In this estimate I omit *Chonetes Logani*, Norwood and Pratten, (not Hall,) *Cardiomorpha ovata*, Hall, and *Cardiomorpha parvirostris*, White, for reasons which will appear in the sequel. *Productus Shumardianus*, Hall, as recognized at Burlington, appears to be *P. concentricus*, Hall, and *Avicula circulus*, Shumard, as recognized at Burlington, is probably *Aviculopecten limæformis*, White and Whitefield.

Leptopora typa, n. sp.—Polypary subcircular in outline, and slightly convex on the general surface; composed (in the specimens examined) of 25–30 rather large cells, of which the internal ones are hexagonal, and the peripheral rounded exteriorly; margins of cups strongly elevated; radial lamellæ about 20.

Diameter of mass ·72;* diameter of the cells about ·14, and their depth about ·07. In a specimen whose diameter is 1·27, the diameter of the cells is ·22.

Ranges from the oölitic bed No. 6 into the base of the Burlington limestone.

This singular coral is not as well known as is desirable. Though discoid, it does not seem to be encrusting. No diaphragms or communicating pores have yet been detected.

TREMATOPORA, Hall.

Trematopora ? vesiculosa, n. sp.—Corrallum delicate, terete, branching, celluliferous on all sides. Cells arranged in spiral and often longitudinal series; cell-mouths oval, slightly elevated on the lower margin, the longitudinal series more or less separated by a straight or flexuous, sharply-raised carina. Surface between the cell-mouths imperforate, but the substance of the corallum beneath is irregularly vesicular. No solid axis exists, the cells appearing to ascend and diverge gradually from an imaginary axis.

Diameter of stem about ·05; length and breadth of cell-mouth ·02 and ·01; distance between the cell-mouths in the spiral series ·01. In some specimens the cell-mouths are somewhat more widely separated.

Base of the Burlington limestone and in the fine-grained sandstone of Ohio.

Trematopora ? fragilis, n. sp.—Corallum delicate, branching, terete or slightly compressed at the bifurcations, celluliferous on all sides. Cell-mouths minute, oval, somewhat remote, not disposed in regular series, more approximate in a transverse than in a longitudinal direction. Intervening surface imperforate; the substance immediately beneath minutely cellular.

Least distance between contiguous cell-mouths about equal to their transverse diameter; greatest distances two or three times as great. The absolute dimensions of the cell-mouths are less than in the last species.

Base of the Burlington limestone.

The two species above described are only provisionally referred to *Trematopora*. They belong to a group often ranged under *Millepora* and *Ceriopora*, but apparently without sufficient reason. The assemblage of branching (or sometimes foliaceous) corals without septa or lamellæ, ranging from the lower Silurian into the Carboniferous limestone, seems to be but imperfectly understood; and the generic and even more fundamental relations are in a state of very unsatisfactory vagueness and confusion.

LINGULA, Bruguière.

Lingula membranacea, n. sp.—Shell flattened, quadrate-ellipitical, nearly as broad near the beak as at the same distance from the anterior margin; length nearly equal to twice the width; lateral margins slightly curved; beak scarcely elevated, near the posterior margin, but with a narrow belt behind it. Shell substance membranaceous, marked externally by very delicate, regular concentric lines.

Length ·50 (100); breadth in the middle ·32 (64); breadth at one-fourth the shell-length from posterior end ·28 (56); breadth at same distance from anterior end ·31 (62).

Differs from *L. concentrica*, Hall, from the Genesee slate by its subequal width at the two extremities. A similar undescribed species occurs in the "fine-grained sandstone" of Ohio.

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* The measurements in this paper are given in inches. Where one number is followed by another in parenthesis, the latter is the relative measurement—the dimensions which is generally the greatest being assumed 100

DISCINA, Lamarck.

Discina patellaris, n. sp.—Upper valve circular, elevated, patelliform, with a subcentral beak, from which the surface slopes in right lines to all parts of the margin, except a barely perceptible concavity down the posterior slope. Surface (of cast) with feeble concentric striæ.

Diameter ·90 (100); height of upper valve ·33 (37); The length appears to be a very little greater than the breadth, but the specimen is slightly defective posteriorly.

This species recalls *D. Alleghania*, Hall, of the Chemung Group, but the apex is more central, and the concentric lines less lamellar and regular, and the shell, so far as known, is smaller.

PRODUCTA, Sowerby.

Producta ? parvula, n. sp.—Shell very small, semi-elliptic or nearly semicircular in outline, with a hinge-line equalling the greatest width, or a little less. Ventral valve ventricose, with regular, though slightly diminishing curvature from beak to anterior margin, describing an arc of about 180°; beak elevated above the hinge-line and incurved over it; flanks regularly convex, abruptly flattened and auriculate at the hinge extremities. Dorsal valve unknown. Surface ornamented with small, rigid, continuous, radiating ribs, which on the sides increase by implantation.

Length from beak to anterior margin ·38 (100); width ·31 (82); depth of ventral valve ·23 (61). The prevailing dimensions are less than the above.

Amongst *Productæ* of similar age the miniature size of the present species renders it at once distinguishable. The specimens look like pygmy examples of *P. cora*, *arcuata* or *pileiformis*.

Producta Martini, (Sow.) de Kon. (*P. semireticulatus*, Martin.)—In the wide range of characters admitted into this species, as defined by de Koninck, there is little doubt that the Burlington specimens would be embraced. Although most of the American species of *Producta* formerly identified with European types have subsequently been separated, *P. Martini* (or *semireticulatus*) is still admitted to exist in our coal measures; and it seems probable that its first appearance dates considerably further back.

Ranges from the bottom of the Yellow sandstones into the Burlington limestones.

+ Producta speciosa, Hall, (Tenth Ann. Rep. Reg. N. Y., p. 176).—Several casts of this Chemung species present the appearance of being inside views of very concave dorsal valves; but no internal structures are visible. The beak is flattened, and not elevated above the hinge-line, which is somewhat shorter than the greatest width of the shell. The other characters also agree.

STROPHALOSIA, King.

Strophalosia ? nummularis, n. sp.—Shell of medium size, circular, truncated by the hinge-line. Hinge-line (generally much) shorter than the greatest width of the shell. Ventral valve comparatively very shallow, regularly arching from the anterior side to the vicinity of the beak, which is obtuse, not incurved and not elevated above the dorsal margin; surface depressed each side of the beak; area apparently present, but very narrow. Dorsal valve discoid, with a broad, shallow umbonal depression, which is bounded on the two sides by lines diverging from the beak at right angles with each other, or nearly so; beak depressed, furnished with a small bifid cardinal process or boss, which lies in the plane of the valve and projects beyond the hinge-line; each branch of the boss continued internally in a low vanishing ridge, which is turned outwardly into the position of a socket ridge, but without the socket behind it;

+ Winchell describes this as a new sp. P. curvirostris, on p. 114

median septum a low ridge appearing a short distance from the beak, and disappearing toward the middle of the valve; vascular imprints sectoriform reaching half way to the midvalve, separated from the median septum by a faint ridge (occlusor apophysis ?) on each side. External surface of both valves with numerous concentric lamellar striæ and innumerable little pits which give the impression a finely granular appearance; pits more scattered and deeper toward the anterior margin. Internal surface (of dorsal valve) exhibiting concentric lines and innumerable raised points, apparently corresponding with the pits of the exterior.

Length ·82 (100); width 1·06 (129); length of hinge-line ·55 (67); length of cardinal process ·04 (5); depression of dorsal valve ·04 (5). Depth of ventral valve ·15, with a length of ·76. Another dorsal valve has a width of 1·46 and a hinge-line 1·22 long.

This anomalous species has more the form of an *Orthis* or *Strophalosia* than a *Producta*. But there is no positive proof of the existence of spines, and the somewhat doubtful existence of an area in either valve furnishes only unsatisfactory grounds for referring it to either genus. At the same time it is difficult to understand how the externally projecting cardinal processes of the dorsal valve could be used without a fissure (and area?) in the ventral valve in which they could move. In view of all the facts, I venture to refer the species with a query to Strophalosia. Should the reference prove correct, it will be, so far as I know, the first identification of this genus in American rocks.

CHONETES, Fischer.

CHONETES MULTICOSTA, n. sp.—Shell of medium size or larger, semicircular, with the greatest width along the hinge-line. Ventral valve depressed-ventricose, more or less flattened toward the hinge extremities, with a barely perceptible mesial sinus reaching two-thirds the distance to the flattened inconspicuous beak; spines two (possibly three) each side of the beak, nearly at right angles with the hinge-line, of medium length, rather stout, the first midway between the beak and cardinal extremity, the second midway between this and the same point; area extremely narrow. Dorsal valve shallow, concave, with a depressed mesial fold extending nearly to the beak; socket plates very divergent; occlusor scars forming a very small elleptic pit near the beak. External surface of each valve bearing 180–200 fine, subflexuous, radiating striæ, which increase dichotomously at all distances from the beak, and sometimes also by implantation. Surface of cast rather remotely punctate.

Length of hinge-line ·82 (100); length of shell ·50 (61); convexity of ventral valve ·12 (14). In most specimens the last measure is relatively less.

Ranges from the base of the yellow sandstones into the base of the Burlington limestone. Intermediate in size between *C. Logani* and *C. Fischeri* of Norwood and Pratten. It possesses a greater number of radiating striæ than *C. Illinoiensis* of Worthen.

CHONETES ILLINOIENSIS, Worthen, (Trans. St. Louis Acad. Nat. Sci., i. 571;) C. LOGANI, Hall, (Iowa Rep. p. 598, pl. xii. fig. 1, a–e and 2,) not *C. Logani*, Norwood and Pratten, (Jour. Acad. Nat. Sci. Philada., [2] iii., p. 30, pl. ii. fig. 12, *a*, *b*, *c*.)

Some confusion seems to exist among the species of *Chonetes* just mentioned. *C. Logani* was described "from the middle portion of the mountain limestone series," at Burlington, Iowa, and characterized as having "about 30 rugose ribs." The figure agrees with the description. Prof. Hall subsequently described a species from the Burlington limestone, of Burlington and Quincy, which he referred to *C. Logani*, Nor. and Prat., though, among the characters, he assigns to it "100–120 or more fine rounded dichotomizing striæ." Still later, Mr. Worthen, conceiving this form to be specifically distinct, gave it the name of *C. Illinoiensis*, remarking that it "is restricted to the crinoidal beds of the mountain limestone," being abundant at Quincy, Ill., and intimating that Norwood and Pratten had erroneously assigned their species to the mountain limestone, in consequence of supposing all the Burlington rocks to belong to that series. The "middle portion of the mountain limestone series," however—even as then understood—would be found far above the yellow sandstones at Burlington. Moreover, in referring *C. Fischeri* to these sandstones at the same locality, they place them "at the base of the mountain limestone." It seems clear, then, that *C. Logani* belongs to the Burlington limestone, but that nevertheless, the species described by Hall cannot be the same, and has been properly separated as *C. Illinoiensis*. The latter species, however, contrary to Mr. Worthen's opinion, occurs frequently in all the beds below the Burlington limestone—having a range co-extensive with that of *C. multicosta*.

SPIRIGERA, (d'Orbigny,) Billings.

SPIRIGERA CORPULENTA, n. sp.—Shell of medium size, extremely ventricose, varying in outline from oval to orbicular-oval. Ventral valve depressed from the anterior margin to the summit of the greatest gibbosity, which is two-thirds the distance to the beak; anterior margin rather deeply sinuate, or very slightly so, sinus soon disappearing in a mere flattening of the valve, or traceable backwards, in a narrow shallow groove, as far as the middle of the shell; umbonal region extremely inflated; beak abruptly turned toward the opposite valve, not produced, truncate, circularly foraminated. Dorsal valve extremely ventricose near the anterior margin, slightly elevated in a mesial fold traceable to the most gibbous region, which is less than half way to the beak; surface depressed between this region and the beak; beak inconspicuous, covered by its fellow. External surface of casts strongly marked by numerous lamellose wrinkles of growth.

Length ·80 (100); breadth ·70 (87); depth of both valves ·58 (72). Breadth and depth of another specimen ·75 and ·68.

The aspect of typical specimens is exceedingly unique. The great gibbosity of the rostral region of the ventral valve and the anterior region of the dorsal, causes the line of junction of the two valves to pass *diagonally* from the anterior to the posterior region. The lateral edges of the two valves, moreover, lie in the same plane, so that the sides of the shell present a regular convexity, like the dorsal and ventral surfaces, and the lines of growth of the two valves, diverging from the postero-lateral region complete the illusion of a dorsal or ventral surface radiately ribbed.

SYRINGOTHYRIS, n. gen.

Etymology, *ςῦριγξ, a tube* and *θῦρίς, a window.*

Shell with an elongated hinge-line. Ventral valve with a mesial sinus, a very broad area, and a narrow triangular fissure closed toward the apex by an external, convex pseudo-deltidium, beneath which, and diverging from it, is another transverse plate connecting the vertical dental lamellæ, arched above, and beneath giving off a couple of median parallel lamellæ, which are incurved so as to nearly join their inferior edges—thus forming a slit-bearing tube, which projects beyond the limits of the plate from which it orginates into the interior of the shell. A low median ridge extends from the beak to the anterior part of the valve. Dorsal valve depressed, without area, with a distinct mesial fold. Shell structure fibrous.

The elevated ventral and deficient dorsal area of this genus, not less than its external pseudo-deltidium, of one piece, ally it to *Cyrtia*, Dalman, and *Skenidium*, Hall. It is not known whether the arms were furnished with calcareous spiral supports, though the general aspect of the shell is that of a *Spirifera*. The shell substance is impunctate in all conditions and under high powers.

Some difficulty exists in deciding on the homology of the transverse plate and fissured tube which characterize this genus. In the ventral valve of *Merista*, especially of the type of *Camarium*, Hall, an arching lamella arises from the basal portion of each dental plate, and the two unite in the mesial line of the valve, forming a structure which Prof. King, before the separation of this genus, had styled the shoe-lifter process,—arched in front, and attached to the bottom of the valve behind. In *Spirifera granulifera*, Hall, a horizontal transverse plate stretches across the middle of the beak of the ventral valve, connecting the dental lamellæ where nearest approximated by their inward curvatures,—a stucture which probably represents the pseudo-deltidium of certain *Spiriferæ*, but not of *Cyrtia*. Beneath this plate, the ventral medium septum assumes the form of a tapering cone, resting with its base filling the cavity and having the anterior part of the upper side marked by a longitudinal groove or slit, while the posterior part sends up a small vertical plate to the transverse plate just mentioned. In *Syringothyris*, the transverse plate equally connects the dental lamellæ where most approximated, and is somewhat arched upward, as in *Merista*, but it does not join the bottom of the valve as in that genus, nor is it connected with the median septum as in *Spirifera granulifera*. Nevertheless it would seem that the three structures are modifications of the same elements.

But what is the element thus modified ? Prof. King suggested that the shoe-lifter process of *Cleiothyris concentrica* is a modified form of the ventral median plate; but the wide separation of its points of origin from the normal position of this plate seems incompatible with such a conclusion; while in *Syringothyris* and *Spiriferæ granulifera* the median plate exists independently of the apparent homologue of the shoe-lifter. Mr. Billings, whose observations are generally marked by extreme sagacity, regards the shoe-lifter "as an abnormal form of the pseudo-deltidium that occurs in some Spirifers." This is the relationship pointed out above; and there seem to exist good morphological reasons for regarding the fistuliferous arching plate of *Syringothyris* as a modified pseudo-deltidium. But to what does the latter structure appertain ? In *Merista*, *Syringothyris* and certain *Spiriferæ* its relation to the dental plates suggests that it may be an outgrowth of those parts. The dental plates are amongst the most heteromorphous structures of the ventral valve. From a normal erect position, they become approximated along the ventral margins in many *Spiriferæ* and other genera, while in *Pentamerus*, *Orthisina* and *Camarophoria* this approximation results in complete union, and in *Leptæna* in the formation of the saucer-shaped process of the ventral valve. They also vary excessively in longitudinal development. In many *Spiriferæ*, moreover, there is an evident indication of a longitudinal folding of the dental plates, producing on one side or the other a longitudinal laminar process, which, under an extraordinary development, may coalesce with some neighboring part. While, therefore, the shoe-lifter process of *Merista*, and still more the fistuliferous diaphragm of *Syringothyris*, may be but modifications of the false inner deltidium of *Spirifera granulifera*, the three structures—accidental among Palliobranchs—may be but mere outgrowths of the essential and typical parts known as dental plates.

The geological range of the above generic type is, as far as known, only from the base of the yellow sandstones at Burlington, Iowa, to the Keokuk limestone. The species from the latter horizon cannot at present be characterized. There are reasons for believing that *Spirifer extenuatus*, Hall, from the yellow sandstones at Burlington, will yet be found to possess the same peculiarities, if it is not a variety of one of the following species.

SYRINGOTHYRIS TYPA, n. sp.—Shell large, thin, externally destitute of radiating ribs, or showing them but faintly. Ventral valve with a broad, undefined, rather shallow sinus; beak extremely elevated; slope thence nearly straight to all parts of the margin; area very large, triangular, flat, forming an angle of about 30° with a line along the bottom of the sinus, and perforated by a rather broad triangular fissure. Dental plates diverging at an angle of 30°, continued nearly to the apex of the beak, and extending anteriorly beyond the middle of the valve. Attachments of the myary system unknown.

+ It is also the very same form Hall had called
Sp. Carteri, in Regents' 10th Report, I think

The external characters of this shell resemble those of *Spirifera simplex*, Phil. (Pal. Foss. p. 71, pl. xxix. fig. 124, and pl. lx. fig. 124), but the hinge-line is more elongate.

This species, so far as is certainly known, is restricted to the base of the Burlington limestone.

Syringothyris Halli, n. sp.—Shell of medium size, transversely elongate, widest along the hinge-line; greatest depth of the two valves equalling or exceeding the greatest length. Ventral valve with a deep, defined sinus; beak very elevated; surface sloping thence with but little convexity, to all parts of the margin,—being sometimes even concave between the apex and the cardinal extremities; area large, triangular, transversely striate, flat or slightly arched, with a more marked incurvation just beneath the beak; perforated by a narrow, or moderately wide, triangular fissure, which is grooved along its lateral borders as if for the reception of a deltidium; dental plates rather short—in a variety, very short—diverging at an angle of 66°; mesial septum a low ridge extending two-fifths the length of the valve; line of divaricator scars extending with a curve from inner end of dental plates to inner end of mesial septum. Dorsal valve moderately ventricose, with a convex surface, and abrupt well-defined mesial elevation, and a small beak which overhangs the base of the fissure in the area of the opposite valve,—the area being scarcely perceptible in the dorsal valve. Surface ornamented by 12 to 16 rounded ribs on each side of the mesial fold and sinus, becoming obsolete toward the lateral angles. Mesial fold and sinus destitute of ribs. The whole surface is further marked by faint, delicate lines of growth.

Length of hinge-line 1·32 (100); depth from beak of ventral valve to most prominent point of dorsal—which is nearly at right angles to the plane of the valves—·70 (53); distance from hinge-line to middle of anterior margin ·54 (41); elevation of (ventral) area ·48 (36); width of fissure at base ·28 (21).

Ranges through the yellow sandstones. In bed No. 1 is a variety with somewhat convex area, very narrow fissure and very short dental plates. The species occurs also at Clarksville, Mo., where the beak of the ventral valve is bent somewhat to the left (this beak being uppermost) in the style of a *Streptorhynchus*, producing a curvature of the mesial sinus and the fissure; and is further peculiarly marked by several distinct lamellar wrinkles of growth.

Named in honor of Prof. James Hall, the eminent Palæontologist of Albany, N. Y.

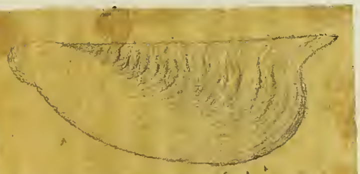
AVICULA, (Klein,) Bruguière.

Avicula Whitei, n. sp.—Shell large, transverse, exceedingly oblique, with nearly terminal beaks. Hinge-line more than three times the greatest dorso-ventral dimension. Anterior ear pouched, not distinctly divided from the body of the shell. Left valve ventricose; umbonal ridge somewhat arcuate, or nearly straight, forming an angle of about 20°, with the hinge-line; slope thence to the ventral margin very rapid—to the dorsal side rather gradual and symmetrical to the very hinge-line—the posterior wing not being divided from the body of the shell. Ventral margin, in the middle rather straight and nearly parallel with the dorsal; posterior margin sigmoidal by a deep, or rather shallow sinus, isolating the posterior end of the cartilage plate from the body of the shell; posterior wing triangular, exceeding the shell. External surface marked by numerous fine, irregular striæ of growth. Right valve much less ventricose, marked on the body and anterior slope by numerous sharp, regular raised concentric striæ which become very faint posteriorly. Cardinal line in each valve with a long, slender, bifid lateral tooth behind the beak.

Length of dorsal side 2·13 (100); greatest dorso-ventral dimension ·70 (33); depth of left valve ·22 (10).

+ Avicula acanthoptera, Hall, (Geol. Rep. 4th Dist. N. Y., p. 26~~3~~).—Shell 4

Winchell afterwards considered this distinct from Hall's sp. and named it Pterinea spinata (see p. 124)



Pterinea Whitei, W.

Comp. P. caudata p. 412.

From the type.

[illegible]

[illegible] Whitei, Winchell. From a specimen in

Mr. Wolf's collection, from Burlington. [illegible]

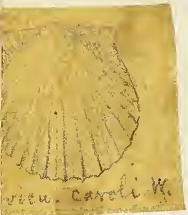
The specimen was identified by Mr. White as [illegible]

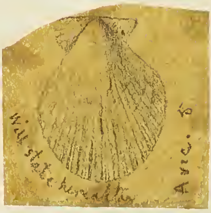
shows in a cross light, the faintest possible traces of [illegible]

-ating lines on the posterior wing. Prof. H. has suggested

in his paper, Proc. Acad. [illegible] 1865, p. 125, that it may be

Pterinea, which is not improbable.

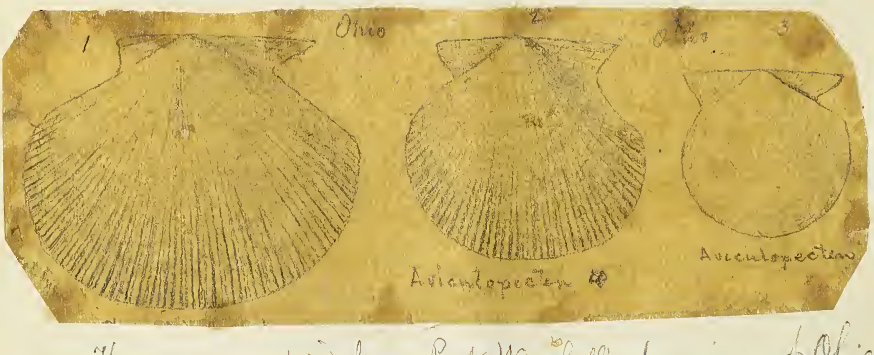

vicu. Caroli W.



[illegible] type, from yell. Sand. at Burling.

W. says this also
occurs in the Burlington
Limestone at Burlington
See p. 125

Prof Winchell had this drawn and I made the above tracing from his drawing, but he could not give me its name if he had named it. He said he would give me its name at some future time. The drawing shows moderately stout costae with several striae between each two of the ribs.



These were copied from Prof. Winchell's drawings of Ohio specimens. No 1, he marked doubtfully A. Caroli, Win. It seems to me however to be certainly distinct from the type of that species (see above sketch) No 2 may be only a var. of No 1, or it may be distinct. No. 3 seems to be the right valve of same rather large, very oblique, becoming distinctly arcuate upwards. Left valve very ventricose, with a tapering, incurved beak, closely approximated to its fellow; body of valve regularly arched along the umbonal slope, from which line it describes a rapid convexity to the anterior margin, sloping more gradually to the ventral margin and becoming gradually flattened toward the posterior ventral angle. The upper boundary of the body is an abrupt descent to the plane of the posterior wing, and sharply divides the two; posterior wing sloping to the dorsal and posterior borders of the valve, produced above into a slender spine, nearly as long as the posterior end of the shell, with a deep sinuation below. Anterior ear short, saccate, less distinctly divided from the body of the valve. Hinge-line straight, with a long, posterior cartilage facet. Surface marked by irregular wrinkles of growth which become fine striæ on the posterior wing, and sharp plications on the anterior slope and auriculation. Right valve smoother and considerably less ventricose, with the posterior wing-surface divided from the body of the valve only by a slight groove.

Length from beak to extremity of posterior wing ·81; from beak to extremity of anterior wing ·21; from middle of dorsal side to ventral side ·70; greatest width of body of shell ·48; same width in a larger specimen ·93; depth of right valve of same specimen ·30.

An occasional specimen of this species, differing from the types of the above description only in the absence of arcuation of the body, presents a good agreement with Prof. Hall's figure and brief diagnosis,—diverging only in the less forward direction of the beak, in the much larger anterior ear, and deeper byssal sinus beneath it. The prevailing forms greatly resemble *Avicula lunulata*, Phil. sp. (Geol. Yorks, ii. pl. vi. fig. 12). It is, however, less oblique, especially in the earlier stages of its growth, and the beak is narrower and more depressed. It is also considerably broader on the antero-ventral side, and has a larger posterior wing.

AVICULOPECTEN, McCoy.

Aviculopecten Caroli, n. sp.—Shell of medium size, subcircular, ventricose. Hinge-line shorter than the shell; anterior ear of right valve shorter than anterior end of shell, rounded, slightly inflated, with a deep, sharply-rounded notch below; posterior ear acute, slightly longer than the anterior, with a broad, shallow notch below; shell otherwise nearly equilateral. Beak central, inconspicuous; greatest convexity of valve a little above the middle. External surface of the body of the valve marked by about 25 nearly equidistant, narrow, sharply-raised, radiating ribs, with two or three fine, raised striæ in each of the interspaces; a set of very fine, sharp, close, concentric raised lines cross the smaller ribs, but are intercepted by the primary ones. The latter, however, show a tendency, toward the pallial margin of the valve, to develope nodes, which, on the anterior and posterior slopes, become distinct spines. The spines sometimes occur in the spaces between the primary ribs. The wings are also marked by two sets of raised lines, but on the posterior wing the radiating set is most prominent, while on the anterior wing the concentric set is strongest. The left valve is exactly like the right, except that the notch below the anterior ear is shallower.

Length from beak to ventral margin ·66 (100); length of hinge-line ·55 (83); convexity of right valve ·20 (30); antero-posterior dimension ·66 (100). Number of concentric lines in one-tenth of an inch, 16. The adult size of the species seems to be about one inch in length and breadth.

Ranges from the base of the yellow sandstones into the base of the Burlington limestone.

X Aviculopecten occidentalis, n. sp.—Shell small, appressed; hinge-line equal to greatest width; anterior and posterior umbonal ridges at right angles, and straight to the middle of the shell extremities, between which the pallial

X. Not Shumard, Mo. Report pl. C.
It seems to me to be [illegible] on the right side
like fig. 3 of [illegible]

margin is regularly curved. Wings distinct, the anterior slightly inflated, rounded at the extremity, and separated from the body of the shell by a rather acute notch, from which a furrow extends to the beak; posterior wing flattened, acute, subtriangular, with a shallow sinus below. Body of shell smooth; wings with radiating ribs, strongest on the anterior wing and crossed by equally strong concentric lines; posterior wing with fine concentric lines.

In the oölitic limestone ("No. 3" of White.)

Aviculopecten tenuicostus, n. sp.—Shell small, equilateral; pallial margin circularly rounded between anterior and posterior extremities, which lie midway between the beak and opposite side. Beak slightly prominent; body of shell bounded by a truncation from beak to each lateral margin; anterior truncation slightly concave. Anterior wing of left valve moderately inflated, as long as anterior side of shell, distinctly rounded at extremity, joining hinge-line by a rounded angle, and separated from body of shell by a broadly V-shaped sinus, rounded at the bottom. Posterior wing only very imperfectly seen. Surface (of left valve) ornamented by fine, rigid, nearly equidistant ribs, 50 or 60 in number, separated by concave intervals; similar but finer ribs or striæ marking the anterior ear. Frequently from three to five equidistant costate elevations appear, each of which bears two or three of the ribs. A few inequidistant concentric lines are seen. Right valve unknown.

Length from beak to opposite side ·47; antero-posterior dimension the same.

It is a little singular that of seven specimens of this species all are left valves, showing only the anterior ear. The posterior is probably flat and thin.

POSIDONOMYA, Brown.

Posidonomya? ambigua, n. sp.—Shell of medium size, rather ventricose, somewhat oblique. Hinge-line short, straight, not surpassed by the inconspicuous beak, abruptly rounded at the extremities; sides of shell subparallel, somewhat straight; ventral margin circularly curved, gaping at the antero-ventral angle. Cast nearly smooth, but bearing the impression of a few small, irregular wrinkles around the margin.

Greatest dimension (from beak to ventral margin) ·65 (100); antero-posterior dimension ·58 (89); angle of umbonal slope with hinge-line 70°.

Three left valves and one right, of an anomalous fossil are here referred with great uncertainty. One of the specimens is larger and relatively longer from beak to venter than the one described, and seems to have been everted around nearly the entire pallial border, producing an extensively gaping shell. The right valve is a smaller specimen, with the beak near the anterior extremity of the hinge-line, and presenting the anomaly of a forward instead of a backward obliquity—in this respect resembling *Streblopteria*, McCoy, but without the anterior wing. The three valves could scarcely belong to the same species of any genus, but it would be folly to attempt a further discrimination at present.

DEXIOBIA, n. gen.

Etymology, *δεξιός*, *on the right side* and *βια*, *strength*, in allusion to the greater ventricosity of the right valve.

Shell thin, inequivalve, inequilateral; beaks separated by an undefined area. Right valve very ventricose, with a very prominent umbo, and a produced, incurved beak, strongly inclined forward. Left valve much less inflated, with a less prominent beak, scarcely elevated above the dorsal margin. Hinge-line more or less extended, straight, or slightly bent, edentulous (?) furnished with a thickened cartilage plate bearing a linear posterior groove. Pallial line and muscular markings unknown.

In his Report on the Geology of Iowa, (p. 522, pl. vii. fig. 10, a, b, c,) Prof. Hall has described, under the name of *Cardiomorpha ovata* (not *C. ovata*, d'Orb.

=*Mactra ovata*, McCoy,) a common species from the yellow sandstones of Burlington. This species Messrs. Meek and Worthen supposed to be congeneric with their *Cardiopsis radiata*, (Proc. Acad. Nat. Sci. Phil., June, 1861, p. 144). From the same beds, Mr. C. A. White has more recently described a similar species under the name of *Cardiomorpha* (*Cardiopsis?*) *parvirostris*, (Proc. Bos. Soc. Nat. Hist., Jan., 1862, p. 31), which has the small beak and Luciniform aspect of several other species referred by authors to the same genus.* It was some time since remarked, however, by Mr. White, that amongst all his specimens of these two species, the left valves of *C. ovata* and the right valves of *C. parvirostris*, were entirely wanting. It appears also that Prof. Hall's description was drawn from a right valve. The idea, however, that the two sets of valves might really belong to one species, would not probably have been entertained but for the discovery of a specimen with both valves in closely fitting juxtaposition. On one side the specimen is *C. ovata*, on the other *C. parvirostris!* The beaks of the two valves are wanting, but the ventral margins apply to each other with exactitude,—the number of radiating lines in a given distance being the same on the two sides.

From the same exhaustless deposits of fossil remains, Mr. White's industry has brought to light some other forms which present similar characteristics.

It is evident that these fossils cannot be referred to any known genus. It is doubtful whether they fall within the limits of any recognized family assemblage. Judging from their analogies, they must have been asiphonal, integropallial Pleuroconchs, though little evidence of the possession of a byssus has been detected. From the inequivalve family *Aviculidæ* (including *Aucella*, to which they are most related,) they are clearly excluded by the greater ventricosity of the *right* valve, and the absence of an anterior wing and byssal sinus. From the free inequivalve *Ostreidæ* their great gibbosity distinguishes them. From *Dolabra*, McCoy, they differ in the greater ventricosity of the right valve and less transverse shape.

In view of the facts above recited, though some palæontologists may not regard them as sufficiently conclusive, I have ventured to publish a diagnosis of the supposed new genus.

Dexiobia Whitei, Winchell, (= *Cardiomorpha ovata*, Hall. + *C. parvirostris*, + White.)—Shell subrotund, with a slight anterior obliquity caused by a moderate protrusion of the antero-ventral border, from which, in the right valve, a slight elevation extends to the beak; anterior margin rather straight above. Hinge-line short, regularly curved; beaks nearly central. Surface marked by fine radiating ribs—becoming obsolete toward the umbo—and numerous irregular concentric wrinkles, which are generally most conspicuous in the left valve.

Height from beak to middle of ventral margin 1·26 (100); greatest antero-posterior dimension, nearly bisecting the first measure, 1·16 (92); convexity of right valve ·45 (35). Height of another specimen 1·67. Height and convexity of a left valve 1·19 (100) and ·26 (22).

Dexiobia Halli, n. sp.—Shell small, semi-elliptic, subequilateral. Hinge-line straight, extended; in some specimens as long as the greatest width of the shell. Right valve extremely ventricose, flattened and subalate toward the hinge extremities; left valve with a very small obtuse beak, and slender posterior cartilage plate bearing a longitudinal median furrow. Surface smooth.

Height from beak of right valve to middle of ventral side ·65 (100); length of hinge-line ·76 (117); ventricosity of right valve ·35 (54).

MYTILUS, Linnæus.

Mytilus Whitfieldianus, Win., (Proc. Acad. Nat. Sci. Phil., Sept., 1862, p.

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* Compare also *Lucina? retusa*, Hall, (Geol. Rep. 4th Dist., N. Y., p. 245), and *Ungulina suborbicularis*, (Ib. p. 243).

+ Why give it another specific name, if it is th
same as Cardiomorpha ovata, and C. parvirostris

413.)—The small shells thus identified have heretofore been regarded as the young of *M. occidentalis*, White and Whitfield,—a species with which I formerly identified the Michigan types of *M. Whitfieldianus*,—a close comparison of specimens, however, shows *M. occidentalis* to be quite destitute of the fine diverging striæ which belong to perfect specimens of the other species. *M. occidentalis*, moreover, is more flattened between the umbonal ridge and the hinge-line, and does not attain more than one-fifth the length of the other. It bears considerable resemblance to *Modiola lingualis*, Phil., (Geol. Yorks. p. 209, pl. v. fig. 21.)

ORTHONOTA, Conrad.

Orthonota phaselia, n. sp.—Shell transversely quadrangular. Beaks inconspicuous, nearly terminal, not raised above the slightly-curved hinge-line. Ventral margin subparallel with dorsal, with a shallow sinuation in the middle. Posterior end truncately curved, a little the most extended toward the dorsal side; anterior end slightly produced below, with a deep lunette above. Shell inflated from the anterior end to near the posterior. Greatest thickness a little in front of the middle. Anterior muscular pit shallow, ovately pyriform. Surface with a few remote concentric lines near the border.

Length ·35 (100); height ·20 (57); thickness of both valves ·13 (37).

EDMONDIA, de Koninck.

Edmondia nitida, n. sp.—Shell small, equivalve, suborbicular, ventricose, slightly oblique, with a subcentral beak. Hinge-line slightly extended posteriorly, obtusely rounded at the extremities; anterior and posterior sides subparallel; ventral border circularly rounded, but a little produced in the line of the umbonal ridge. Beak elevated above the hinge, obtuse, slightly incurved; umbonal ridge making an angle of 68° with the hinge-line; behind this ridge the slope is abrupt to the posterior border; middle portion of the shell very slightly flattened from the beak along the region anterior to the umbonal ridge. Surface handsomely marked by rigid, regular concentric raised striæ, with a few remote, irregularly-distributed concentric furrows. The striation is preserved in all its sharpness to the very hinge-border.

Length ·59 (100); height ·59 (100); thickness of both valves ·30 (51).

Closely resembles *E. unioniformis*, de Kon., (Anim. Foss., pl. i. fig. 4,) but the latter is less finely and elegantly striated, and shows no flattening along the region between the beaks and the ventral border. It is much less flattened and less angular than *E. binumbonata*, Win., from Michigan.

Edmondia nuptialis, n. sp.—Shell of moderate size, transversely-suboval; in adult specimens considerably inflated in the vicinity of the pallial border. Beaks subcentral, small, incurved, somewhat elevated above the moderately extended, slightly arcuate hinge-line. Ventral margin gently curved or nearly straight in the middle; more rapidly curved toward the rounded, subequal extremities. Hinge structure obscure, but apparently consisting of one or more lateral teeth on each side of the beak. Surface unequally and interruptedly furrowed. Greatest thickness through the middle of the shell.

Length ·79 (100); height ·62 (78); thickness of both valves ·50 (63).

This species is relatively larger than *E. nitida*, and is destitute of the obtuse angulations descending along the anterior and posterior umbonal slopes of the latter. An associated, if not identical, species is less ventricose, with less central beaks, and can scarcely be distinguished from *Lucina? retusa*, Hall.

Edmondia strigillata, n. sp.—Shell rather small, rather gibbous, transversely oval; beaks subcentral, elevated, obtuse, somewhat strongly turned forward. Ventral margin gently arcuate in the middle, more rapidly curved toward the neatly-rounded extremities, of which the posterior is broadest. Hinge-line curved, furnished with a pair of rather thick lateral teeth; cardinal teeth, apparently none. Surface marked by fine radiating lines, and toward the margin by a few irregular concentric wrinkles.

Length ·80 (100); height ·62 (77); thickness of both valves ·40 (50).

Resembles *E. nuptialis* in form, but it is less ventricose around the margin, and is further distinguished by its radiating striæ.

Edmondia æquimarginalis, Win., (=*Cardinia æquimarginalis*, Win., Proc. Acad. Nat. Sci. Phil., Sept., 1862, p. 413.) The identification with the Michigan species is quite conclusive, but the better state of preservation of this fossil necessitates a correction of the generic reference.

See p
127–413

* Edmondia (?) bicarinata, n. sp.—Shell rather small, transverse, oblong, a little the widest at the posterior extremity of the straight, lengthened hinge-line; dorsal margin erect, not inflected; ventral margin subparallel with the dorsal, having a distinct shallow sinus near the middle, which leaves a diminishing furrow extending to the beaks; angularly rounded to the extremities, of which the posterior is truncate by a slightly curved line at right angles with the hinge-line, and another above this forming an angle of about 135° with the hinge-line. Beaks one-fifth the length of the shell from the anterior end, somewhat flattened, and incurved over a deep, distinct lunette. Greatest convexity one-third the distance from the dorsal to the ventral sides. A strong angular ridge extends from the beaks to the posterior ventral angle, and another, less conspicuous, to the angle connecting the two posterior truncated margins. Surface marked by fine incremental lines, parallel to the basal and posterior borders.

Length ·59 (100); height ·27 (41); thickness of both valves ·12 (20).

Edmondia (?) elliptica, n. sp.—Shell rather large, appressed, transverse, with an elongate-elliptical outline. Beaks flat, inconspicuous, situated one-fifth the shell-length from the anterior end. Hinge margin elongate, slightly curved, abruptly elevated; a flattened area extending from the beaks backward to the posterior hinge angle. Extremities neatly rounded. Surface marked by numerous distinct unequal lines running parallel with the pallial margin.

Length 1·36 (100); height ·65 (48).

SANGUINOLITES, McCoy.

— See lea
opposite
page

Sanguinolites amygdalinus, n. sp.—Shell of medium size, equivalve; length equal to two and a half times the height; beak about one-fourth the length from the anterior end, scarcely elevated above the hinge, somewhat depressed, incurved; dorsal margins slightly concave, posteriorly inflected inwards, forming a deep escutcheon; ventral margin gradually curved along the middle, more rapidly so toward the extremities; posterior extremity describing nearly a semicircle, and joining the dorsal line by a very easy angle; anterior extremity abruptly rounded to the deep, broad lunette, which reaches from the beak to the middle of the shell. Greatest protuberance one-third the distance from the beak to the venter, rather tumid; an obtuse angulation extending from the beak to the postero-basal angle; a strong internal ridge running near to, and parallel with, the hinge-line. Surface marked by strong concentric wrinkles, which nearly disappear in the dorsoumbonal region. A shallow sinus in front of the mid-ventral margin, which can be traced upward toward the beak.

Length ·97 (100); height ·44 (45); distance of beak from anterior end ·25 (26); from posterior ·72 (74); thickness of both valves ·36 (37).

Somewhat resembles *Allorisma Hannibalensis*, Shum., but differs in the absence of the "broad concentric ribs" of that species. It less resembles the Burlington fossil, usually referred to the same species.

Sanguinolites cylindricus, n. sp.—Shell small, equivalve; length equal to two and a half times its height; beak about one-seventh the length from the anterior end, elevated above the hinge-line, flattened and enrolled; greatest height along the perpendicular from beak to base; dorsal margin extended,

* Accord. to H & W. this is the same as cypricardia? rigida White & Whit. and they (H & W) refer it to Sanguinolites

slightly concave upwards and inwards, sharply inflected inwards, forming a long, deep posterior escutcheon or cartilage base; ventral margin nearly straight, curving rapidly from a point opposite the beaks to the anterior extremity, which is abruptly rounded into the deep heart-shaped lunette; posterior extremity truncated by a line extending from the basal to the dorsal margin, and making with the latter an angle of 120°. Valves very ventricose, the greatest thickness being behind the central point on the sharp, prominent umbonal plication, which extends from the beak to the postero-basal angle—the area between this plication and the anterior region being curved subcylindrically from a dorsal to a ventral direction, and the area between the plication and the hinge-line being a triangular, twisted, somewhat concave surface, faintly marked by lines diverging from the beak to the posterior boundary. Entire surface covered with fine irregular striæ parallel with the basal and anal margins.

Length ·63 (100); height ·29 (46); thickness of both valves ·24 (38); height of posterior end ·20 (32); length of anterior end ·09 (14); of posterior end ·54 (86).

A peculiarity of this fossil is its cylindrical ventricosity and the posterior position of its greatest distension. (Compare Owen, Geol. Rep. Wis., Min., &c., Tab. III. A, fig. 18.)

SANGUINOLITES IOWENSIS, n. sp.—Shell of medium size, equivalve, transverse; height equal to nearly one-half the length; beaks elevated above the dorsum; subappressed, incurved and turned forward over a deep cordate lunette; dorsal line straight, reaching to near the posterior extremity of the shell; dorsal margin sharply inflected to form a long cartilage base; ventral border gently curved, posteriorly receding toward the dorsum, and forming at the extremity an angle of 80° with the short, truncate, nearly rectilinear hind margin; anterior extremity most projecting in the middle, from this point curving regularly to the ventral border and abruptly into the anterior lunette. Valves ventricose, most inflated in the middle; a sharp carina running sigmoidally from the beak to the postero-basal angle; another, still sharper, bounding the (posterior) escutcheon; the twisted triangular space between these being marked, on the cast, by three faint depressed lines, radiating also from the beak. External surface marked by irregular lines of growth, strongest on the anterior portion and faintest on the dorso-umbonal surface. In some specimens apparently not separable from this species, a shallow groove runs from the ventral margin nearly opposite the beak, over the umbo.

Length 1·03 (100); height ·52 (50); thickness of both valves ·38 (37); length of anterior end ·21 (20); of posterior end ·82 (80).

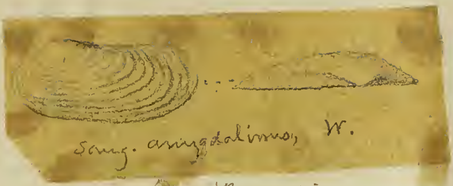
The forms last mentioned above attain a size fully once and a half as large.

The typical specimens of this species are quite distinct, but the larger ones approximate to *S. amygdalinus* in outline and characters of the dorsal region; but they differ in being larger, more ventricose, and in having a sharp umbonal angle and acute posterior extremity.

+ SANGUINOLITES SULCIFERUS, n. sp.—Shell very small, transversely oblong, with nearly terminal beaks. Ventral margin broadly and rather deeply sinuate in the middle; anterior margin abruptly rounded below, terminating above in a deep lunette; posterior margin somewhat produced below, suddenly rounded at the basal angle, and very obliquely truncate from thence to the end of the second third of the dorsal side, from which point the straight hinge-line extends to the beak. Cardinal margins inflected to form a narrow, elongate escutcheon. Umbo full; umbonal ridge arcuate, with the convexity upwards, and terminating at the posterior basal angle; space above this somewhat concave, longitudinally marked by seven or eight strong imbricating concentric ridges.

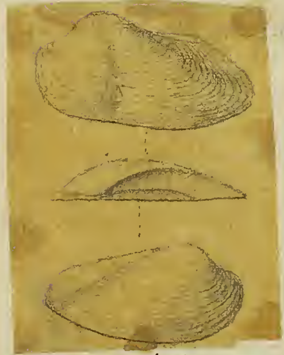
Length ·26 (100); height ·14 (54); thickness of both valves ·09 (35).

+ Not Sanguinolites, but almost certainly Cypricardina, Hall.

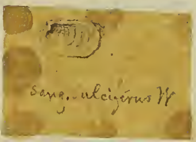


Sang. amygdalinus, W.

See p. 13.

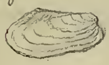


Sanguinolites Iowensis, Winch.; from Winchell's unpub. figure



Sang. ulcigerus W

I have seen a species from the Waverley sandstone, from Bagdad Medina Co; Richfield, Lodi &c Ohio, that I believe to be the same as this. Well preserved specimens show very minute radiating striæ between the large costæ. It agrees exactly with Prof. Winchell's description, excepting that the card. margin does not appear to be inflected to form a narrow elongated escutcheon, as he says, at least not well defined. The fine striæ on the spaces between the concentric ridges consist of two sets that cross each other obliquely thus . The outline of this Ohio shell is like this



. It seems to belongs to Cypricardina, Hall.

Comp. Cypricardia? Chouteauensis, Swallow
Tr. St. Louis Acad. Sci. Ap. 1862, p. 96

Resembles in external form *Arca pinguis*, de Kon., (Anim. Foss., 116, ii. 11). Compare also *Cypricardia parvula*, (pl. ii. fig. 3).

The Hamilton group of New York furnishes a fossil similar to the above; and the Waverly sandstone of Ohio another similar, perhaps identical, one.

Sanguinolites (?) jejunus, n. sp.—Shell of moderate size, equivalve, transverse; beaks small, barely elevated above the hinge, slightly inflected, one-third the shell-length from the anterior end; height fully half the length; hinge-line extended; dorsal slope erect, marked by an internal ridge; margin slightly inflected, if at all, though some indication exists of a very narrow escutcheon; anterior lunette equally inconspicuous; ventral margin symmetrically arcuate between the extremities, with which it connects by similar gradually increasing curvatures; posterior end truncate for a short space near the termination of the hinge-line, with which it forms an angle of about 130°; anterior end semi-elliptically rounded. Valves somewhat appressed; greatest distension one-fourth the distance from the beak to the venter. Surface of cast marked by faint lines of growth.

Length ·86 (100); height ·48 (55); length of anterior end ·31 (36); of posterior ·55 (64); thickness of both valves ·20 (23).

Some specimens associated here are relatively shorter posteriorly, but not otherwise distinguishable.

McCoy's generic names and distinctions,—*Sanguinolites* and *Leptodomus*,—seem preferable to King's *Allorisma*, inasmuch as the latter name, besides being subsequent in time, was originally defined under an erroneous idea, and was finally left to embrace shells regarded as sinupallial,—a character which does not seem to belong to the so-called *Allorismas* of the Palæozoic period. *Sanguinolites Iowensis*, and probably some of the others just described, are allied in form to *Cypricardia;* but I agree with Pictet and others in believing that, while we have no evidence of the existence of the teeth of *Cypricardia* in any of the Palæozoic species generally referred to that genus, it is more natural to throw them into another association. Moreover, the sharply-inflected dorsal margin and broad, elongate posterior escutcheon, present in all the species of *Cœlonotidæ*, would seem to indicate real affinities, and thus withdraw the *Allorisma* type entirely from the association in which it has been placed. *Cypricardia? rigida*, White and Whitfield, from the same rocks, is a *Sanguinolites.*

CARDIOMORPHA, de Koninck.

Cardiomorpha trigonalis, n. sp.—Shell small or of moderate size, triangular, rather ventricose, with elevated, incurved beaks. Ventral margin slightly convex anteriorly, slightly sinuate near the posterior angle; anterior angle regularly rounded to the subtruncate anterior side; posterior angle rather acute, formed by the termination of the sharp postumbonal ridge, from which the surface descends precipitously to the truncate posterior margin. Hinge-line short, rounded, edentulous. Greatest thickness a little above the middle of the shell. Surface marked only by faint incremental striæ; younger specimens smooth.

Length ·82 (100); height ·72 (88); thickness of both valves ·50 (61).

This species has been sometimes regarded as *C. rhomboidea*, Hall, but none of the numerous specimens of it exhibit the least trace of radiating lines. The outline, moreover, is subtriangular instead of subrhomboidal. (Compare with *C? triangulata*, Swallow, St. Louis Trans., i. 655.)

ARCA, Linnæus.

Arca modesta, n. sp.—Shell small, very ventricose, quadrate-oval, with a posterior alate prolongation of the hinge-line. Beaks subterminal, incurved, separated by a ligamental area; posterior hinge-line straight, nearly as long as the shell. Umbonal ridge and body of the shell inflated to the ventral margin; alate expansion gradually flattened; anterior end abruptly rounded, excavated by a lunuliform area in front of the beaks; posterior end rounded below, truncate above. Surface covered by fine, rather regular, sharp, concentric striæ; the alate expansion bears also faint traces of two or three furrows diverging from behind the beak.

Length ·31 (100); height ·22 (71); thickness of right valve ·10 (32); angle between hinge-line and umbonal ridge 35°.

This little species closely resembles *A. arguta*, Phill., sp., var. de Kon., (Anim. Foss., pl. iii. fig. 12.) The beaks, however, are still more terminal than in that variety, and the lunette is not so sharply bounded. *Arca arguta*, var., is from carboniferous limestone—Visê. Though the dental characters of the present species have not been observed, it can scarcely prove to be anything but an *Arca* or *Macrodon.*

MACRODON, Lycett.

Macrodon cochlearis, n. sp.—Shell of moderate size, rather ventricose, length equal to twice the height; beaks subterminal, flattened, incurved. Ventral border straight, or slightly sinuate in the middle, symmetrically curved toward the extremities; posterior extremity truncate from the hinge-line one-third its width; anterior extremity most projecting above the middle, excavated above by a small deep lunette; dorsal line straight, nearly as long as the shell, not inflected; posterior cardinal extension with feeble indications of one or more lateral teeth. Surface finely striated concentrically.

Length ·88 (100); height ·44 (50); length of anterior end ·16 (19); of posterior end ·72 (81); thickness of left valve ·18 (22).

Resembles *M. parvus*, White and Whitefield, but, besides its larger size, it is much less ventricose, especially in the posterior half, and has not the conspicuous muscular pits of that species.

NUCULA, Lamarck.

Nucula microdonta, n. sp.—Shell small, transversely oblong; height equal to two-thirds the length; beaks small, somewhat incurved, but little elevated above the hinge-line, about one-third the length from the short end. Ventral border rapidly curved, and regularly so to the vicinity of the long end, where it is slightly sinuated, from which point a shallow groove extends up nearly to the beak. Dental plates but little angulated between the beaks; the larger bearing near its outer margin 10 or 12 minute transversely tubercular teeth, and the shorter 4 or 5. Teeth not distinguishable to the beaks, but no cartilage pit seems to be present. Anterior muscular pit oblong, surmounted by a large pedal scar. Shell most ventricose in the middle. No surface markings discernible.

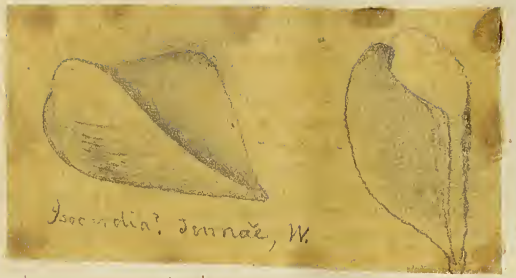
Length ·47 (100); height ·32 (68); length of short end ·18 (38); of long end ·29 (62); thickness of both valves ·18 (38).

This little species is readily distinguished from *N. Iowensis*, and most others of this age, by its very small teeth and the absence of the usual nuculoid outline.

Ranges from bed No. 5 into the base of the Burlington limestone.

LEDA, Schumacher.

Leda saccata, n. sp.—Shell very small, transversely elongate, rostrate at the longer extremity; obtuse, ventricose and saccate at the other. Beak abruptly, though moderately drawn out, and but slightly incurved. Ventral side strongly curved, becoming nearly straight toward the rostral extremity. Dorsal region deeply excavated for an escutcheon on the longer side of the beak; hinge plates bearing each six or seven teeth. Greatest thickness of shell between the beaks and the middle. Pit of adductor of short end very deep



Isocardia? Jennae, W.

It is not gaping behind, as I know from examining the type specimen

Certainly not Isocardia, but probably a new genus of the family Anatinidae.

on its superior border; the other pit smaller, deepest on its superior border Surface with fine, indistinct striæ of growth.

Length ·32 (100); height ·16 (50); length of short end ·13 (41); of long end ·19 (59); thickness of both valves ·13 (41).

ISOCARDIA Lamarck.

Isocardia? Jennæ, n. sp.—Shell of rather large size, triangular, very ventricose. Beak elevated above the hinge, flattened, incurved and directed forward, with a deep lunule in front. Hinge-line extended posteriorly; alate expansion more or less flattened, posterior border truncated at right angles with the dorsal line, elongate; antero-ventral margin nearly straight throughout the lower two-thirds of its length, forming an angle of 50° with the posterior border, above gradually curved to the lunette. An elevated sharp umbonal ridge runs sigmoidally from the beak, arching first backwards, then forwards, and again backwards to the posterior ventral angle; the posterior slope from this ridge becomes more and more steep in approaching the beak, at and near which it faces dorsally, and is overhung by the umbonal ridge. A shallow sinus appears in the middle of the antero-ventral margin, from which a furrow ascends toward the beak. Surface marked with faint incremental lines which, on the antero-ventral slope near the base, become distinct, and nearer the beak rise in well marked wrinkles converging in the lunette. Greatest length from beak along the umbonal angle 1·27; length of hinge-line ·81; length of shell posterior to the beak ·65; length of posterior side ·90.

This species, in its essential features well marked, seems, nevertheless, to be quite variable. In some specimens the posterior alate portion is much more developed. In others it is less developed, and the umbonal ridge is more acute, giving the shell the appearance of being truncated through its thickest part.

There is no direct evidence of the affinities of this species with *Isocardia*, except the swollen umbones and enrolled beaks; and it is so referred, mainly, in deference to high authorities who have made similar disposition of such forms. (See Sandberger, Verstein., pl. xxvii. fig. 11). It has the posterior wing of the *Aviculidæ*, and also the ventricose left valve and enrolled beak of *Aucella* in that family. Yet it differs from *Aucella* in having the right valve equally ventricose, and in being entirely destitute of an anterior wing and byssal sinus. The sharp, sigmoid umbonal angle is a feature seen in some species usually referred to *Cypricardia* (See *C. bipartita* de Kon. Anim. Foss., p. 94. pl. fig. 15).

Finally, it is worthy of mention that the peculiar angular form of this species is but an exaggeration of the characters of *Sanguinolites cylindricus*. It is relatively shorter, more ventricose and more flattened on the posterior cardinal angle. If external form is to be the basis of family distinctions and alliances, (See Agassiz, Cont. to Nat. Hist. of N. A.) then *Isocardia Jennæ* will go with *Sanguinolites cylindricus*, Win., *S. decipiens*, McCoy, *Cypricardia rigida*, W. and W., *C. bipartita*, de Kon., *Isocardia cœlata*, Sandb., &c., &c., into a family whose circumscription has not yet been marked out.

CARDIOPSIS, Meek and Worthen.

Cardiopsis megambonata, Win. (Proc. Acad. Nat. Sci., Sept., 1862, p. 417.) —The specimen here referred is many times larger than the types of the species, being of the size of *C. crenistriata*, Win., from which it differs principally in the coarser and more rigid ribs and more prominent beak.

The ribs in the Burlington specimens do not increase in number with age, and scarcely increase in size; the intercostal spaces are flat, gradually widening.

Height from beak to ventral margin ·91 (100); length ·85 (97); thickness of left valve ·55 (60).

SANGUINOLARIA, Lamarck.

SANGUINOLARIA ? LEPTOGASTER, n. sp.—Shell small, thin, subquadrangular. Beaks subcentral, flat, not elevated above the dorsal line. Posterior end obliquely truncated; anterior gently rounded below, abruptly above, with a long deep lunette; ventral side arcuate in the middle, joining the extremities by a gradually increased curvature. Umbo flattened,—a low ridge extending obliquely to the posterior basal angle. Dorsal line straight behind the beaks, joining the posterior side at an angle of 125°. Surface marked by fine regular striæ parallel with the ventral and posterior margins.

Length ·53 (100); height ·38 (71); thickness of valves ·09 (17).

BELLEROPHON, Montfort.

BELLEROPHON CYRTOLITES, Hall, (Thirteenth Rep. Reg. N. Y., p. 107).—A small Bellerophon, laterally appressed, and with an acute periphery, approaches too closely to *B. cyrtolites* to justify discrimination. It is known, however, only by its cast, which is quite smooth. Should the identification prove correct, this species occurs at Rockford, Ind., Marshall, Michigan, and Burlington, Iowa.

PORCELLIA, Léveille.

PORCELLIA RECTINODA, n. sp.—Shell small, gradually enlarging, marked by a series of transverse nodes, which are strongest on the dorso-lateral region, and gradually diminish to the middle of the side; transverse section between two nodes subcircular. Dorsum unknown.

Diameter of last whorl about ·59; dorso-ventral diameter of tube near the aperture ·19.

This species differs from *P. crassinoda*, White and Whitefield, in its circular section and transversely elongate nodes—from *P. obliquinoda*, White, in the transverse position of the nodes—and from *P. nodosa*, Hall, (Geol. Surv. Ia., Supplem. to vol. i. part 2, p. 92), in its much smaller size and different geological horizon,—the latter being found in the upper bed of the Burlington limestone, which has thus far furnished no species identifiable with fossils from the sandstones below.

DENTALIUM, Linnæus.

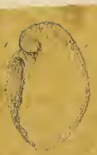
DENTALIUM GRANDÆVUM, n. sp.—Shell rather large, perfectly straight and terete, or a little compressed; tapering ·09 in one inch near the larger end, less rapidly near the small end; surface marked by faint, irregular incremental striæ, which run obliquely around the shell, and in flattened specimens are most advanced along one edge.

Length of largest specimen 2·18; diameter at larger end ·21; at smaller end about ·05.

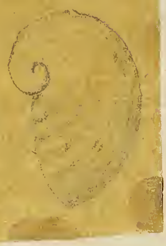
This species resembles *D. venustum*, Meek and Worthen, (Proc. Acad. Nat. Sci., Phila., June, 1861, p. 145), from the St. Louis and Spergen Hill limestones. The latter, however, tapers but ·075 in one inch, and is described as "nearly" straight and quite smooth, while the present species is rigidly straight and transversely striated.

PLATYCERAS, Conrad.

PLATYCERAS CORNUFORME, n. sp.—Shell small, describing about half a whorl, very rapidly enlarging, similarly curved throughout, broadly and obtusely carinated, when young, along the peripheral line; transverse section becoming subsequently nearly circular; aperture a little oblique to the whorl, with a somewhat sinuous peristome,—the principal sinus being just beneath the middle of the outer lip. Surface marked only by striæ of growth, which curve forwards on the sides, and backwards along a belt just beneath the periphery. The shell is nearly symmetrical and its curvature planorboid. The apex is blunt and not perceptibly turned to the right or left.



P. Vomerinum



These figures were traced by me from Prof. Winchell's drawings. He wrote the name P. vomerinum between the two figures but I am in doubt now whether he meant for the upper or the lower figure; or for both. Neither, however, seems to agree very well with his description.

Murch. quadricosta
W.

Height when resting on the aperture ·32; summit in this position two-thirds the distance from the aperture to the apex; width of aperture ·33.

Platyceras vomerium, n. sp.—Shell of medium size, describing about half a direct whorl, very rapidly enlarging; peripheral (or dorsal) region elevated and surmounted by a strong, broad, rounded carina, which becomes more obtuse toward the aperture,—a shallow groove running along each side of the carina; transverse section showing an angle of about 70° toward the beak, which enlarges to about 110° near the aperture; surface of cast destitute of markings.

Distance from front of aperture in a straight line, to most projecting portion of beak ·85 (100); height of shell when resting on the aperture ·47 (55); summit when in this position three-fifths the distance from aperture to apex; length of aperture ·67 (79); width of aperture ·58 (68).

This sharp-backed species approaches *P. carinatum*, Hall, (Fourteenth Rep. N. Y. Reg., p. 5,) but differs in being equilaterally developed. It belongs to the *Orthonychia* group, which Prof. Hall has welded to the Neritoid forms under one generic designation.

Believed to range from the base of the yellow sandstones into the base of the Burlington limestone.

PLEUROTOMARIA, Defrance.

Pleurotomaria? rota, n. sp.—Shell small; spire depressed, convex, consisting of four or five flattened whorls; suture sharply channelled as if by the rabbet of a joiner. Base of shell unknown, but a solid axis in the cast of the spire would indicate a deeply perforate umbilicus. No surface markings.

While the imperfect specimens plainly indicate an undescribed species, it is as yet impossible to determine the generic position of the shell.

Ranges from bed No. 5 into the base of the Burlington limestone.

Pleurotomaria tectoria, n. sp.—Shell small; spire trochoid, consisting of about four whorls, flattened between the periphery and the suture; periphery marked by a raised, somewhat bicarinate band; a raised carina running along the upper margin of each whorl close to the suture; base rounded regularly from the periphery to a small, sunken, perforate umbilicus; aperture subcircular, somewhat modified by the body whorl, angulated posteriorly, rounded in front,—the peristome descending into the umbilicus.

MURCHISONIA, d'Archiac.

Murchisonia quadricincta, n. sp.—Shell of medium size, turrited; whorls convex, regularly enlarging to the last, with an obsoletely bicarinate band running along the middle, below which are four small, rigid, thread-like, approximated carinæ, leaving the base of the body whorl smooth or faintly lined, and regularly curved into the umbilical cavity; the surface above the band marked only by very delicate lines of growth, which arch backwards to the peripheral band, below which they arch far forwards, entering the umbilical cavity half their length in advance of their place of origin at the suture. Suture deeply impressed.

The only specimen showing the external markings has a defective spire, but it could not be completed with less than 8 or 9 whorls, giving a length of 1·8 (100); an apical angle of 19°, a sutural angle of 66°, while the body whorl is ·25 (14) high.

Some internal casts—perhaps of the same species—have double the above dimensions, and exhibit a shallow longitudinal groove on the penultimate whorl near the suture, which, in the ultimate whorl, becomes a broadly concave flattening of the upper region, and a somewhat sharp angulation at the suture. In these, the outer lip is rounded, the inner somewhat excavated, and the aperture is angulated and slightly effuse in front. Still other casts exhibit a more elevated spire, with the smooth, rounded whorls barely in contact, the body whorl disproportionately enlarged, the aperture effuse and the general aspect that of *Lóxonema;* but the condition of the specimens renders it unsafe to undertake to decide on specific or even generic characters.

The general appearance of this species is like that of *M. bilineata*, Goldf. (Petr. Germ. iii. 24, Taf. clxxii. 1,) but the four carinæ below the band render it easily distinguishable. The casts recall *Turritella obsoleta*, Sow. from the old red sandstone of Felindre.

Murchisonia neglecta, n. sp.—Shell of moderate size, turreted, with an apical angle of 12°. Suture impressed, whorls convex, slightly flattened above the middle, bearing a bilinear band below the middle close to the suture. Surface marked by faint, transverse, sinuous striæ, which, on the outer portion of the body whorl, appear to assume the character of transverse wrinkles.

Described from a defective specimen, but the bicristate band on the lower side of the whorls is sufficient evidence of its distinctness. It seems to have consisted of 8 to 10 whorls.

Murchisonia Shumardiana, n. sp.—Shell small, conical, consisting of six or seven gradually enlarging whorls, somewhat flattened on the base and outer surface, so as to leave but a shallow suture; body whorl obtusely angulated at the junction of the basal and lateral surfaces; aperture broadly cuneate-ovate, angulated behind, scarcely effuse in front; plane of aperture parallel with vertical axis of shell. Surface of cast quite smooth.

Height of shell ·57 (100); height of last whorl ·24 (42); diameter of base of shell ·28 (49); length of aperture ·23 (40); greatest width ·17 (30); apical angle 34°.

Much resembles the young of *M. prolixa*, W. and W. It differs in more rapidly enlarging whorls, larger apicial angle and the obtuse angulation limiting the basal surface.

STRAPAROLLUS, Montfort.

Straparollus Barrisi, n. sp.—Shell of medium size, depressed-turbinate; whorls four or five in number, moderately impressed, rather gradually enlarging to the last, which enlarges somewhat rapidly; surface generally convex, with three rounded, barely perceptible angulations.—the first near the somewhat channelled suture, the second along the periphery, and the third at the brink of the medium-sized umbilical cavity. Base of the body whorl sometimes slightly flattened, giving an increased transverse diameter to the section, —a feature which is associated with a somewhat greater depression of the spire.

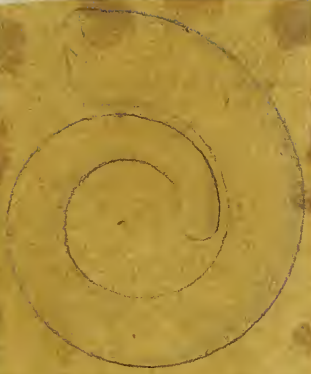
Diameter of one of the largest specimens ·96 (100); height ·67 (69); height of body whorl ·46 (48); transverse diameter of body whorl near aperture ·38 (40); approximate diameter of umbilicus ·29 (30); spiral angle 100°.

This somewhat resembles a species in the Burlington limestone, but the spire is somewhat more elevated, the suture deeper and the whorls are less rapidly enlarged.

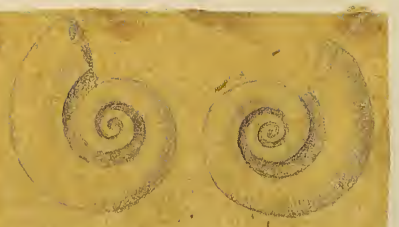
Straparollus macromphalus, n. sp.—Shell of moderate size; spire little elevated; whorls barely in contact, graduallly enlarging, with a nearly circular section, and circumscribing a broad dish-like umbilical cavity, open to the apex of the spire. Surface of the whorls marked by distinct regular striæ of growth, which arch slightly backward in descending the umbilical cavity, and terminate with a slight forward curvature.

Diameter of shell ·84 (100); transverse diameter of body whorl near aperture ·25 (30).

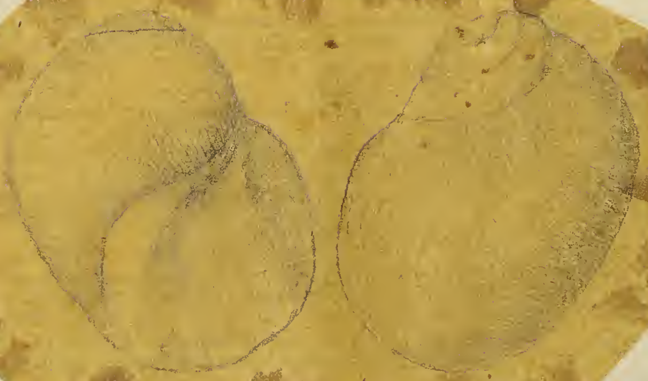
A close analogue of some forms of *Euomphalus lævis*, d'Arch. and Vern., and can only be distinguished by its wider umbilicus and slightly sigmoid striæ on the base of the body whorl. *Straparollus costellatus*, McCoy, (Pal. Foss., 538, pl. 3 H. fig. 3,) is a closely-related form, but differs in some of its surface markings and its larger number of whorls.



Strop. macromphalus, W.



Phan. paradoxus, W.



M. pinguis, W.

PHANEROTINUS, J. Sowerby.

Phanerotinus paradoxus, n. sp.—Shell of medium size, discoid; whorls four, widely disjoined, rather rapidly enlarging, nearly terete; spire depressed below the level of the outer whorl, causing a slightly deeper concavity above than below the shell; upper side of last whorl with a scarcely perceptible undulation in the middle, and another on the slope of the umbilical depression; under side regularly curved; faint incremental lines running directly around the whorl.

Diameter of shell 1·0 (100); diameter of aperture at right angles with peripheral line ·33 (33); same dimension one revolution back from the aperture ·14 (14).

The faint appearance of angulations on the upper side may be deceptive; in which case, the greater depression of the spire on that side would indicate it as the base of the shell, and the whorls would be sinistral.

The only specimen of this unique species—so far as I know, the first of the genus noticed in America—is in the form of a gutta-percha cast, taken from natural moulds in friable sandstone, of the spiral and basal sides of the same individual. The moulds themselves it was impossible to preserve. The nearest American analogue of this species is *Euomphalus laxus*, Hall, (Fifteenth Rep. Reg. N. Y., p. 54, pl. vi., fig. 2).

HOLOPEA, Hall.

Holopea conica, n. sp.—Shell very small; spire elevated, consisting of about three or four rounded whorls, of which the last forms about four-fifths of the entire length; suture distinct; aperture lying nearly in the plane of the axis of the spire, ovate, acutely angulated behind, neatly rounded in front; outer lip thin, regularly convex; inner lip almost equally convex, slightly thickened by the nearly continuous peristome. Surface not satisfactorily known, but apparently smooth.

Length ·27 (100); length of body whorl ·20 (74); width of body whorl ·18 (67); length of aperture ·12 (44); width of aperture ·08 (29); spiral angle 44°.

This little species generally resembles *Holopella mira*, but the apical angle is greater, the body whorl more developed and the aperture more angulated behind, with a less continuous peristome.

Holopea subconica, n. sp.—Shell small, breadth equal to its height; spire turbinate, consisting of two or three rounded, rapidly enlarging volutions, bounded by a distinct suture; aperture subcircular, with a slightly interrupted peristome; outer lip thin; base gracefully rounded into the minutely-perforated umbilicus, which is closely bordered by the free columellar lip. Surface apparently smooth.

Height about ·15 (100); width of last whorl ·16 (94); height of last whorl ·09 (56); apical angle about 80°.

Associated with *Holopea conica* and *Holopella mira* in the calcareous bed "No. 3."

MACROCHILUS, Phillips.

Macrochilus pinguis, n. sp.—Shell globoid; spire short, rapidly tapering; volutions not more than five, largely overlapping; suture moderately impressed; body whorl ventricose, broadest in the middle, somewhat flattened above; aperture ovate, its longer axis forming an angle of 27° with the axis of the shell, acute posteriorly, abruptly rounded anteriorly; inner lip flattened, with indications of a columellar fold. Surface marked by faint directly transverse striæ of growth.

Height of shell 1·93 (100); height of body whorl 1·41 (73); height of spire ·52 (27); length of aperture 1·44 (74); width of aperture ·93 (48); spiral angle 85°.

This species is related to some of the globose forms from the Coal Measures.

Its closest analogue is *M. primigenius*, Hall, (Io. Rep. p. 720, pl. xxix. 11.) =*M. ponderosus*, Swallow, (Trans. Acad. Sci., St. Louis, i. p. 202). The aperture, however, is broader, the spire less elevated and the columellar fold apparently much less pronounced.

From the lower bed of the yellow sandstones—being, until the recent description of some specimens from the Hamilton Group of New York, (See Fifteenth Rep. N. Y. Reg., p. 48), the lowest known position of this section of the genus.

LOXONEMA, Phillips.

Loxonema oligospira, n. sp.—Shell small; whorls about six, rather rapidly enlarging, convex exteriorly, with traces (on the cast) of vertical ridges, which become most observable in the vicinity of the aperture; suture deep; body whorl three-fifths the length of the shell, more rapidly enlarging than the spire, gently convex on the outer side, more rapidly curved toward the base—which is somewhat umbilicately indented—rapidly increasing in diameter toward the aperture, which is thus rendered somewhat effuse in front.

Height of shell ·41 (100); height of body whorl ·25 (61); diameter of body whorl ·29 (71); diameter of penultimate whorl ·16 (39).

HOLOPELLA, McCoy.

Holopella mira, n. sp.—Shell small, turrited; whorls gradually and regularly enlarging, seven or eight in number, of which four or five are generally preserved,—the apical ones, in numerous specimens, uniformly wanting; whorls sometimes slightly flattened on the exterior; suture distinctly but not deeply impressed; body whorl regularly rounded beneath into a minute umbilicus; aperture nearly circular, obtusely angulated behind, regularly rounded in front; peristome complete or slightly interrupted; columellar lip without a fold, very slightly excavated by the aperture.

Height of shell about ·24 (100); height of body whorl ·11 (46); diameter of body whorl ·14 (58); apical angle 35°.

This little shell occurs gregariously in calcareous layers of bed No. 3, and also occasionally in sandstone No. 5. The exterior seems to be destitute of natural ornaments, but the specimens in bed No. 3 are universally marked by lines like cleavage cracks, running very obliquely across the several whorls,—their lower extremities being nearest the aperture.

This fossil bears a close resemblance to *Turritella* (*Holopella*) *gregaria* and *conica*, Sow., (Murch. Sil. Syst., pl. iii. fig. 1, f. and 8) from the old Red Sandstone, but it differs from both (See McCoy, Pal. Foss., p. 303,) in apparently having no natural surface markings.

NATICOPSIS, McCoy.

Naticopsis depressus, n. sp.—Shell small; spire of about four volutions, scarcely elevated above the body whorl; last whorl rapidly enlarging, especially in an obliquely transverse direction; suture very shallow, giving the upper side of the shell a general convexity; width of last whorl at the aperture three-fifths the transverse diameter of the shell; aperture oval, rounded anteriorly and posteriorly; within, somewhat contracted on the inner side by the broad, flattened columella; surface marked by delicate lines of growth, which, toward the suture, become, on the last whorl, fine, regular, elongated nodes. Highest point of shell, when resting on its base, is on the last whorl, near the junction of the outer lip with the penultimate whorl.

Height of shell from antero-lateral margin of aperture obliquely to summit of spire ·50 (100); greatest transverse diameter ·59 (118); width of body whorl measured in the same direction ·36 (72); altitude of shell when resting on its base, in a direction nearly at right angles with the last measure ·30 (60); length of aperture ·37 (74); width ·32 (64).

ORTHOCERAS, Breynius.

Orthoceras Whitei, n. sp.—Shell annulated, very gradually tapering, with very deep concave septa, and a somewhat elliptic section. Major angle of divergence 5° in a specimen about four inches long, giving a taper of ·09 in the space of one inch; ratio of axes of transverse section ·98 : 1·32 = 1·34; ratio of concavity of septa to greater diameter ·38 : 1·2 = 3·16 ; annulations, ten in the space of three inches, where the mean transverse axis is 1·27, making their distance a little less than one-fourth this axis, the plane of the annulations forming an angle of 74° with the longitudinal axis of the shell, the opening generally toward the extremity of the shorter diameter; the annulations having a broad, shallow, retral sinuosity, which in some specimens is distinctly marked, and in others obscure; position of the sinuosity somewhat variable; space between the annulations regularly concave; a peculiar obsolescence of the annuli sometimes occurs along the side marked by the sinuosity, and not unfrequently a partial or nearly complete obsolescence of entire annuli takes place along a portion of the shell. Siphon large, situated on the longer diameter two-sevenths of the distance from the centre to the periphery. Surface (of cast) marked by feeble, rounded, encircling striæ, which generally run parallel with the annulations, but sometimes cross them at a small angle.

The deep concavity of the septa is a strong distinctive mark of this, amongst annulated species. In many specimens this is much deeper than in the large specimen from which the measurements have been taken. The occasional obsolescence of the annulations may also be noted.

Orthoceras heterocinctum, n. sp.—Shell unequally annulated, rather rapidly tapering, with a nearly circular section and a subcentral siphon. Angle of divergence 11°; annulations inequidistant, strong, rounded, separated by concave intervals, somewhat oblique and slightly sinuated retrally on one of the sides, very often becoming more or less obsolete, and sometimes entirely disappearing; septa slightly oblique; siphon on the longer diameter less than its own diameter distant from the longitudinal axis of the shell. Surface marked by unequal striæ running parallel with the rings.

Resembles *O. Whitei* in the occasional obsolescence of the rings; and casual observation would not distinguish the two. The present species, however, tapers more rapidly, is less compressed, has a less excentric siphon and exhibits a much more frequent disappearance of the annuli.

Ranges from the base of the yellow sandstones into the base of the Burlington limestone.

Orthoceras Indianense, Hall, (Twelfth Rep. N. Y. Reg., p. 10.)—Numerous specimens of an *Orthoceras* having a circular or slightly eccentric section, a central or subcentral siphon and an angle of divergence of about 8° fail to furnish any characters for distinction from the above species. If such identification is correct, this species enjoyed considerable geographical range.

Ranges from the bottom of the yellow sandstones into the base of the Burlington limestone, in company with crinoids regarded as characteristic of the latter formation.

PHRAGMOCERAS, Broderip.

Phragmoceras expansum, n. sp.—Shell slightly arcuate in the earlier stages of growth, becoming nearly straight at a later period; somewhat gradually enlarging at first, but afterwards expanding with great rapidity, finally undergoing a gradually reduced rate of expansion, which, at the aperture of the adult, amounts to a slight constriction; transverse section very slightly compressed laterally; position of siphon unknown; septa transverse, moderately concave. Surface of cast smooth.

In a specimen which is ·70 in diameter at the small (imperfect) end, the same diameter increases to 2·1 in the space of 1·37 inches, showing an angle of divergence of about 68°.

CYRTOCERAS, Goldfuss.

Cyrtoceras unicorne, n. sp.—Shell arcuate; angle of divergence when young about 11°, rapidly increasing with the growth of the shell to 35° or 40°; transverse section laterally compressed, with the dorsum a little more acute than the venter; last chamber fully half the length of the shell. Septa transverse, regularly concave. Siphon rather large, terete, somewhat close to the dorsal margin. Surface apparently without ornaments; incremental lines forming a variable angle with the septa.

A specimen which is 2·23 long is ·38 in dorso-ventral diameter at the small (imperfect) end, and 1·60 at the larger end, being septate the whole length. Another specimen must have been about 2·3 in dorso-ventral diameter at the larger end.

PHILLIPSIA, Portlock.

Phillipsia insignis, n. sp.—Head paraboloid; border wide, broadly and deeply furrowed, with the margin reflected upward, and the lateral angles continued posteriorly in acuminate prolongations, reaching twice the length of the glabella from the anterior end; the margin and reflected portion of the test marked by fine longitudinal striæ. Glabella elongate-paraboloid, tuberculated. In the middle of the posterior border of the glabella is a pair of tubercles, and in front of these a second and third pair, the last resting on the middle of the glabella—the whole so arranged as to form two longitudinal rows; opposite the first pair are the two small complementary lobes, with four pustules on the summit of each; opposite the second pair, on each side, a transversely elongate tubercle with a trifid crest; opposite the first pair, a similar tubercle with a bifid crest; the ornaments on the posterior half of the glabella being consequently arranged in three transverse series, in the posterior of which are ten elevations, in the middle eight, and in the anterior six; the anterior half of the glabella is covered by pustules somewhat promiscuously arranged, and varying in different specimens. Eyes large, globoid, slightly excavated by the palpebral lobe of the fixed cheek, situated opposite the posterior third of the glabella. Occipital ring broad, with its posterior margin elevated nearly as high as the posterior extremity of the glabella, and ornamented with a row of small, raised points turned backwards. Pygidium very convex, semielliptic, the axis very prominent and forming about one-third the width at the anterior margin; consisting of twelve to fourteen rings, each bearing six small tubercles, the whole of which are arranged in six longitudinal rows; the tubercles often worn down on the exterior of the test, but always well defined in the cast; lateral lobes bent rather abruptly downwards, having ten ribs, which become indistinct and disappear toward the margin, and are entirely wanting over the narrow space behind the axis; the anterior ribs showing a faint median groove toward their vanishing extremities, and a a few of the posterior ones bearing feeble tuberculations toward their axial extremities.

The pygidium of this species nearly resembles that of *P. truncatulus*, Phillips, sp. (Geol. Yorks, ii. p. 240, pl. xxii. fig. 13.) but the head is widely different.

From the base of the Burlington limestone.

Phillipsia Maramecensis? Shumard.—Border of head of medium width, regularly convex, separated from the glabella by a narrow, distinct furrow. Glabella oblong, slightly quadrangular, a little broader behind than before, convex, highest in the middle; complementary lobes obliquely oval, protruding a little beyond the lateral boundaries of the glabella, from which they are separated by shallow depressions; a diminishing series of three feeble lobes in front of each complementary lobe; surface of glabella smooth to the naked eye, but under a lens finely granulated. Eyes opposite the last quarter of the glabella.

The fragment above described is associated with the pygidium described by Dr. Shumard, (Mo. Rep. Part ii. p. 199, Pl. B. fig. 9,) simply in consequence of the granulated surface of the two, and the impossibility of proving them distinct. The original specimen, however, was obtained from the "Archimedes limestone" of St. Louis County, which, according to Prof. Hall, is the equivalent of the "Keokuk limestone."

Of the foregoing species, four are not positively known to occur below the base of the Burlington limestone; but they are confidently embraced in the fauna of the yellow sandstones, for the reason that they ascend no higher, and that of the 131 remaining species constituting that fauna, not less than 40 are known to range upwards to the same horizon.

University of Michigan, Dec. 6th, 1862.

Pursuant to the By-Laws, an election of members of the Standing Committees for 1863 was held, as follows:

ETHNOLOGY.

J. A. Meigs,
S S. Haldeman,
I. I. Hayes.

COMP. ANAT. AND GEN. ZOOLOGY.

Joseph Leidy,
J. M. Corse,
J. H. Slack.

MAMMALOGY.

J. H. Slack,
John Cassin,
J. L. Le Conte.

ORNITHOLOGY.

John Cassin,
S. W. Woodhouse,
J. H. Slack.

HERPETOLOGY & ICHTHYOLOGY.

E. D. Cope,
R. Bridges,
J. C. Morris.

CONCHOLOGY.

T. A. Conrad,
W. G. Binney,
G. W. Tryon, Jr.

ENTOMOLOGY AND CRUSTACEA.

R. Bridges,
Samuel Lewis,
E. T. Cresson.

BOTANY.

E. Durand,
Joseph Carson,
Aubrey H. Smith.

GEOLOGY.

Isaac Lea,
Charles E. Smith,
J. P. Lesley.

MINERALOGY.

Wm. S. Vaux,
J. C. Trautwine,
T. D. Rand.

PALÆONTOLOGY.

Joseph Leidy,
T. A. Conrad,
J. L. Le Conte.

PHYSICS.

B. Howard Rand,
Wm. M. Uhler,
R. E. Rogers.

LIBRARY.

Wm. S. Vaux,
Joseph Leidy,
Joseph Jeanes.

PROCEEDINGS.

Robert Bridges,
Joseph Leidy,
Wm. S. Vaux,
John Cassin,
Thomas Stewardson.

February 3d.

The President, Mr. Lea, in the Chair.

Nineteen members present.

The following were presented for publication:

Systematic arrangement of the Mollusks of the Family Viviparidæ and others inhabiting the United States. By Theodore Gill.

Enumeration of the Arctic Plants collected by Dr. I. I. Hayes, in his Exploration of Smith's Sound, etc. By E. Durand, T. P. James and S. Ashmead.

Mr. Cope mentioned the occurrence in the males of certain species of tree-toads of the genus Trachycephalus, of a corneous thickening of the epidermis of the interior metatarsus during the breeding season, similar to that in the genus Discoglossus. Also, that in certain South American Bufones the manubrium sterni is present, although, up to the present time, it has been denied that such is the case.

February 10th.

The President, Mr. Lea, in the Chair.

Twenty-nine members present.

The following was presented for publication:

Remarks on the North American Ægiothi. By Elliott Coues.

Mr. Lea read part of a letter from Dr. Lewis, of Mohawk, New York, in which he said that he was gratified with one thing which was not apparent to him at first. In his notes on *Melania subularis*, Lea, and *M. exilis*, Hald., two species of his neighborhood, he finds an evident confirmation of Mr. Lea's views about *Trypanostoma* and *Goniobasis*, to which two sections of *Melanidæ* the two species belong. The soft parts affirm the correctness of Mr. Lea's generalizations from the shells. Dr. Lewis thinks the *sinus* in the sides of *subularis* is peculiar, and will be found in the whole group of *Trypanostoma* and the *granular sides* of *exilis* in the whole group of *Goniobasis*. It becomes now a curious speculation what may be the characters of *Anculosa*, *Schizostoma*, *Lithasia*, *Io*, &c.

Dr. Wilcocks read an extract from M. Arago's "Astronomie Populaire," vol. i. p. 459: "I have been anxious to ascertain who first noticed the existence of blue stars. The ancients only spoke of white and red ones. In the latter class they placed Arcturus, Aldeboran, Pollux, Antares and Orionis, which are still red. To this list (and the circumstance is worthy of remark) they added Sirius, whose whiteness strikes all eyes. It seems, then, that with time certain stars change color. The first observation (known to me) made of a blue star, occurs in the Treatise on Colors, by Mariotte, published in 1686."

Dr. Wilcocks stated that he had read the extract from M. Arago's work as a preface to an observation of his own,—viz.: that the star Sirius is no longer white; its present color is violet.

If the star, instead of undergoing a single change of color in the lapse of ages, should take in succession all the hues of the spectrum, it adds much to the interest of the subject, and will certainly give an impetus to inquiry concerning the cause of these remarkable changes.

Mr. Ennis remarked that this announcement by Dr. Wilcocks appeared to him deeply interesting, from the fact that for the past year he had made the colored, the variable, the periodic, the lost, and the temporary stars a special

F. B. Meek,
Recd. Nov. 30th 1865

Descriptions of New Species of FOSSILS, from the Marshall Group of Michigan, and its supposed equivalent in other States; with Notes on some Fossils of the same age previously described.

BY PROFESSOR ALEXANDER WINCHELL.

The following paper is intended to constitute a further contribution to our knowledge of certain western rocks occupying a position near the boundary line between the carboniferous and Devonian systems.* The materials for this paper have been in part collected by the writer in Michigan, Ohio, Indiana, and Iowa. Further material has been found amongst the *investiganda* of the "White Collection" of the University of Michigan. Col. Charles Whittlesey's collection of fossils from the "Fine Grained Sandstone" of Ohio, has also been placed in the writer's hands for study. In addition to this, the latter has spent several days with Prof. James Hall in his cabinet, engaged in making direct comparisons between the fossils of the rocks under consideration, and the types of the Chemung group, preserved in his magnificent collection. An opportunity has also been enjoyed of making a hasty survey of the fossils from the same horizon, contained in the extensive collection of the Illinois Geological Survey, for which the writer's acknowledgments are due to the Director, A. H. Worthen, Esq.

The reader will observe that all the identifications heretofore made with typical Chemung fossils from New York and Pennsylvania, have been abandoned. On critical comparison between actual specimens, it has appeared that the differences—some of which have always been admitted—are of too important a character to permit the identification formerly assumed. On the other hand, the following paper discloses an extended network of identifications amongst the fossils from States west of Pennsylvania. But perhaps the most interesting feature of all is the identification of four western species with fossils, contained in the supposed carboniferous conglomerate of western New York. These are *Euomphalus depressus*, Hall, (=*Straparollus Ammon*, White), *Cypricardia contracta*, Hall, (= *Edmondia ? bicarinata*, Winchell), *Edmondia æquimarginalis*, Win., and *Allorisma Hannibalensis*, Shumard.* Considering the small number of fossils as yet discovered in this conglomerate, in New York—and these only at one locality (four miles north of Panama, Chautauque County)—so considerable a number of identifications is calculated to excite some surprise, and not a little hope, that we are getting glimpses of the clue to a solution of geological difficulties of long standing.

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*Former papers by the writer, on the same subject, may be referred to as follows: "First Biennial Report" of the Geological Survey of Mich. 1860; Amer. Jour. Sci. and Arts, [2] Vol. xxxiii. p. 352; ib. [2] xxxv. p. 61; Proc. Acad. Nat. Sci. Phil., Sept. 1862, p. 405; ib. Jan. 1863, p 2.

But further than this, two of the above species—*Edmondia æquimarginalis* and *Allorisma Hannibalensis*—occur in what has been regarded as *another* conglomerate, whose position is beneath the first and at the top of the Chemung rocks of Western New York.

In the light of these identifications, and in the absence of all identifications between western species and those of the Chemung, as well as between the species of this conglomerate and those of the Chemung, it might not seem unreasonable to doubt its affinities with recognized Chemung rocks, and to suspect its continuity with the supposed "carboniferous conglomerate," until observation shall have demonstrated that its stratigraphical position is really below that formation. And further, since we must probably abandon the attempt to coördinate the Chemung of New York with the fossiliferous portions of the sandstones and shales of the west lying between the "Black Slate" and the coal conglomerate, it seems not unlikely that we may yet be able to prove the conglomerates of Western New York to be the attenuated and littoral eastern prolongation of those western sandstones and shales—at least of the superior and fossiliferous portions of them; so that the latter would stand as a hitherto unrecognized group of strata lying at the very base of the carboniferous system; while the Chemung rocks of New York fall within the Devonian system, toward which the writer is now inclined to think that their paleontological affinities attract them.

It yet remains to determine by observations in the field, whether the so-called "carboniferous conglomerate" of Western New York is really the equivalent of the coal conglomerate of Ohio; and whether any actual junction of superposition can be discovered in Western Pennsylvania or Eastern Ohio, between the Chemung rocks in their westward prolongation and the fine grained sandstones and gritstones of the Western States.

The total number of species at present described from the rocks under consideration is about 379, of which 170 were first described by the writer, and four have been recognized as belonging to undescribed genera. The number of species noticed in the present paper is 94, of which 36 are described as new species, and two are made the types of new genera.

Descriptions and Notes of Species.

CONOPOTERIUM n. gen.

Etymology. Κῶνος, *a cone,* and ποτηριον, *a little cup.*

Generic Characters. Corallum compound, generally free, sometimes adherent, but without a distinct base of attachment. Cells somewhat crowded,

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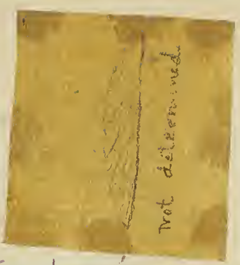
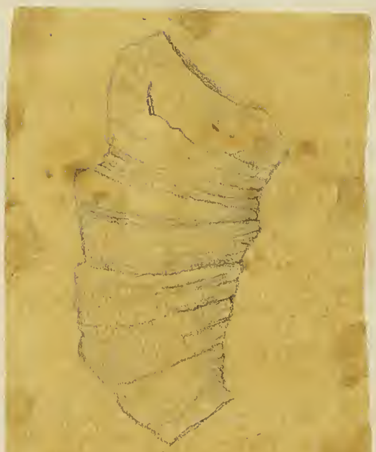
* The writer is under special obligations to Prof. Hall for the unreserved liberality with which he has been allowed to examine the specimens in his cabinet, as well as for many kindnesses incident to the generous hospitality of his house.



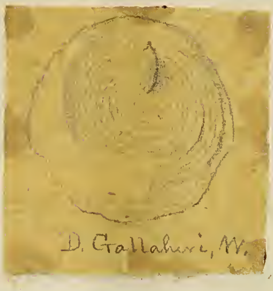
not determined

I copied these from Prof. Winchell's drawings but he said he had not yet named them



Zaph. Ida, W.

Rockford



D. Gallaheri, W.

See p. 112

rapidly enlarging, inseparable, with only occasional and rudimentary diaphragms, and no radial lamellæ. Walls marked internally by vertical striæ, and a few pores which communicate between the cells. Exterior, where exposed, covered by an epitheca, marked only by irregular encircling striæ. Cells increasing laterally and interstitially.

This genus, perhaps, approaches nearest to *Sphenopoterium*, Meek and Worthen. It differs in the absence of the cuneate form of the base [illegible] in *Sphenopoterium*—the cell mouths in this genus being turned indifferently in all directions. The cells also are smaller and more numerous ; and the fewer mural pores communicate from cell to cell, instead of terminating in the intercellular substance. But one species has thus far been observed.

Sec

Conopoterium effusum n. sp. Corallum small, spheroidal, consisting of 20 to 50 cells, which are crowded, subcircular or irregularly angulated in transverse section, feebly striated internally, and having a thick, feebly wrinkled epitheca. Specimens presenting cells of all sizes. Some tendency is manifest toward a proliferous growth ; some of the lateral cells becoming adherent by their sides to a foreign body.

Diameter of largest mass, ·58 ; diameter of mouth of largest cells, about ·20.

From the Lithographic Limestone, Clarksville, Mo., "White Collection" of the University of Michigan.

ZAPHRENTIS, Rafinesque et Clifford.

Zaphrentis Ida n. sp. Coral simple, of medium dimensions, in the general form of an inverted cone, strongly curved, with numerous encircling wrinkles of growth, and an occasional deep constriction. Epitheca rather thick, though the vertical lamellæ show faintly on the exterior. Cup very oblique, turned toward the shorter side, with a distinct fossette reaching from the centre to the shorter side. Radial lamellæ 31 in a specimen ·62 inch in diameter. On the side opposite the fossette is a thick lamella reaching from the periphery to the centre ; one-sixth of the circumference on each side of this is another lamella reaching to the centre, and at the same interval from these are two others ; in the fossette, near the periphery, is the rudiment of a sixth. The remaining lamellæ do not extend to the centre but become confluent in each sextant, with the principal lamella which lies between them and the fossette—the fossette taking the place of a principal lamella. There are thus, in each sextant, four subordinate lamellæ joining their primaries, except that in one of the sextants adjacent to the fossette there appears a supernumery lamella, caused apparently by the splitting of the shortest subordinate or the one next the fossette. Taking no account of this anomaly, the whole number of lamellæ is 30, a multiple of six instead of four.

The spaces between the lamellæ are intersected by thin transverse diaphragms arranged at unequal distances, and either flat or concave upwards. There is no correspondence in the positions of the diaphragms in contiguous interlamellar spaces ; and the wrinkles of the epitheca sustain no relation to them, since they are not continuous, but are intercepted by vertical interlamillar walls ; and besides, they nearly disappear in the peripheral region of the internal cavity.

Collected by A. Winchell, in the Goniatite Limestone at Rockford, Indiana.

The septal system of this coral is described above as senary instead of quaternary. The senary arrangement, as a fact, is sufficiently apparent ; and yet it must probably be regarded as illusory—the primary lamellæ being four instead of six, and the illusion being produced by the mode of confluence of the lamellæ of the second and third cycles.

Zaphrentis acutus ? White and Whitfield.

Occurs in the Lithographic Limestone of Clarksville, Missouri. "White Collection" of the University of Michigan.

FAVOSITES, Lamark.

Favosites ? mancus n. sp. Coral a small hemispherical mass, with an obtuse apex; principal cell-mouths very small, sub-circular; those occupying the interstices smaller and angular; cell-walls strong, prominently raised above the general surface. Cells rapidly enlarging and multiplying by frequent gemmation. No pores, striæ or diaphragms have been discerned.

Diameter of polypary, ·68 inch; largest cell-mouths, ·05 inch in diameter.

This differs from *F. divergens*, White and Whitfield—the only other species described from rocks of this age—in its extremely diminutive proportions, and in the apparent absence of diaphragms. There is perhaps as much reason for referring this species to *Conopoterium* as to *Favosites*.

Collected by A. Winchell, in the Goniatite limestone of Rockford, Indiana.

Trematopora ? vesiculosa, Win. Specimens undistinguishable from the Iowa species, in their existing state of preservation, have been collected by A. Winchell, at Alan's quarry, in Hillsdale, Michigan.

Lingula Cuyahoga, Hall. Numerous specimens, not distinguishable from this species, were obtained by the writer from fragments of a hard, calcareous, brecciated rock, quarried from a well on the premises of Judge Alan, at Hillsdale, Michigan. The geological position is apparently in the lower part of the Marshall group. The rock here is the nearest approach in physical characters that has yet been seen to the Goniatite limestone at Rockford, Indiana.

Occurs also in the "Fine-grained sandstone beneath the coal at Ward's mine, Wethersfield, Trumbull County, Ohio—conglomerate wanting." Whitlesey's collection.

DISCINA, Davidson.

Discina Gallaheri, n. sp. see last [illegible]

Shell of medium size, nearly circular. Ventral valve with the apex slightly excentric; foramen lanceolate, reaching from near the apex four-fifths the distance to the margin, and acute at both extremities. Surface marked by about fifteen rigid, sharp, sub-equidistant striæ, which are somewhat more approximated toward the apex. The striæ are less distinct on the shell than upon the cast.

Dorso-ventral diameter about 1·0; transverse diameter about 1·0; distance from apex to dorsal side, ·48; length of foramen, ·33.

Found at Hillsdale, Michigan, on the premises of Rev. F. A. Gallaher, in a small loose fragment having the lithological characters of the lower gray portions of the neighboring Marshall sandstone. It occurs also in Col. Whitlesey's collection from Girard and Wethersfield, in Trumbull County, Ohio.

I at first referred the specimens to *D. Newberryi*, Hall, (xvi. Rep. N. Y. Regents, p. 30,) but direct comparison with the types of that species shows that it differs in having more remote, stronger and more regularly equidistant concentric striæ. In its striation it resembles *D. grandis*, Hall, from the Hamilton group, but the form is more circular and the striæ are relatively less remote.

Discina capax, White, (1864.) Identified in Whittlesey's collection, "from rocks next below the coal canal level, one mile below Girard," and also at "Girard, Trumbull County," Ohio.

The types of *D. Newberryi*, Hall, (1864,) do not seem to be distinguishable from this species.

PRODUCTA, Sowerby.

Producta gracilis, n. sp. Shell small, aperture of the ventral valve forming a little more than a semicircle. Ventral valve moderately inflated for a Producta, with flattened, smooth, triangular auriculations; hinge-line equal to greatest width of shell; mesial sinus wanting or barely perceptible; external surface marked by fine, rigid, sharp, once dichotomizing radial lines or ribs, numbering about 40. No indications of spines have been detected.

Length of hinge line, ·29 (100); length from beak to anterior margin, ·21 (72).

Described from an imperfect ventral valve; but its peculiar characters easily distinguish it.

Museum of University of Michigan, Collected by A. Winchell at Valley Forge, one and a half miles below Cuyahoga Falls, Ohio.

Producta duplicostata, n. sp. Shell rather large with subcircular outline. Ventral valve very ventricose and greatly arched, with steep slopes to the right and left margins, not enlarged at the aperture, and entirely destitute of mesial sinus; marked with numerous interruptedly and irregularly striate sinuous ribs, which dichotomize once or twice in the middle region of the valve, and towards the front resolve themselves each into a fascicule of three or four smaller ribs, themselves raised into a wider rib-like elevation around the anterior margin. The tubular spines are scattered over the whole exterior, but become much more abundant at the commencement of the marginal costate ridges. The whole exterior of the cast is marked also by oblique punctations, which are placed mostly in irregular lines between the ribs, and become consequently most abundant toward the margin. On the sides of the cast the punctations become elongated into short furrows which cross the surface obliquely.

Length, 1·19; breadth, 1·24; convexity of ventral valve, ·58; number of marginal ridges, 15 to 20.

Collected by A. Winchell, at Battle Creek, Michigan. Occurs also in Licking County, Ohio.

Producta morbilliana, n. sp. Shell small, transversely subelliptic, only moderately produced. Hinge line seven-eighths the greatest width of the shell; ears small, nearly right angled. The shell regularly contracts from the aperture to the beak, which is small, subacute, and projects slightly beyond the hinge. The arching of the shell is such that when resting on the aperture the greatest height is equal to one-half the greatest width. No sinus or flattening present. The surface is marked by a series of deep, continuous, equidistant wrinkles, ten or eleven in number, becoming obscure toward the beak; between the wrinkles are numerous fine concentric striæ not easily seen without a magnifier. These features are crossed by a longitudinal system which, near the beak, is a set of fine regular costæ, which near the middle become interrupted by the wrinkles, and, losing their identity, result in several concentric bands of short longitudinal tubes buried in the substance of the shell, and gradually emerging and presenting their apertures anteriorly.

Transverse diameter of aperture, ·58 (100); length of hinge line, ·51 (88); distance from hinge line across the aperture to opposite side, ·44 (76); height of shell when resting on the aperture, ·26 (45).

From the base of the Burlington limestone, Burlington, Iowa. "White Collection" of the University of Michigan.

A cast from the yellow sandstone below (probably "No. 5,") is probably identical with this.

This beautiful species is most nearly related to *P. speciosa*, Hall, (xth Rep. N. Y. Reg. p, 176.) The resemblance, however, is not striking, except in the cast referred to. This differs in having the pustules more regularly arranged in concentric bands. *P. morbilliana* may also be compared with *P. Rogersi*, Nor. and Prat., (Jour. Acad. Nat. Sci. Phil. [2] iii. 9, pl. i. 3, a, b, c, not *P. aspera* McChesney.) It is, however, a much neater species, without trace of sinus, not so full near the beak, while the rib-like tubes arranged along the concentric bands are smaller and more regular. Its nearest foreign analogue is *P. punctata*, Sowerby, (Min. Conch. iv. 22, pl. 323.) Its surface features, in point of regularity, are intermediate between the extremes presented by that variable species; but it differs constantly in the absence of a sinus.

Producta curtirostra, n. sp. Shell of moderate size, semi-globoid, without mesial sinus. Hinge line nearly equal to greatest width of valve, with but slight flattening in the region of the extremities. Beak scarcely surpassing the hinge line, extremely flattened; general surface regularly convex, marked by numerous interrupted, sub-obsolete costæ, and, in the umbonal region, by numerous concentric wrinkles, most distinct upon the ears. The inside of the dorsal valve presents an appearance very similar to the outside of the ventral valve.

This is the species formerly referred by me (Proc. Acad. Nat. Sci. Phil., Jan. 1863, p. 4,) to *P. speciosa*, Hall. A careful comparison of specimens, however, fail to justify this identification. It most nearly approaches *P. lacrymosa*, Hall. The remarkable features of the beak of the ventral valve, and the great concavity of the dorsal, are, however, characters which distinguish this species from all others. *P. lacrymosa* has less fulness in the region of the cardinal extremities, giving the umbo less breadth and greater isolation from the ears.

From the yellow sandstone, Burlington, Iowa. "White Collection" of the University of Michigan.

Producta dolorosa, n. sp. Shell of medium size, somewhat hemispherical, outline subcircular or somewhat transverse, truncated along the hinge line, which is considerably shorter than the greatest width of the shell. Ventral valve regularly convex, with scarcely an apparent flattening at the hinge extremities; beak depressed, obtuse, slightly surpassing the cardinal line. Dorsal valve but slightly concave, with a low and inconspicuous median septum reaching to the middle of the valve; the muscular scars presenting together a somewhat semicircular contour, in front of which the interior of the shell presents a finely papillose area. External surface presenting a series of elongated pustules, or interrupted, irregular depressed costæ, and a few coarse concentric wrinkles, between which the surface is covered with fine concentric striæ.

Length from hinge, in a straight line to front margin, ·54 (66); transverse diameter, ·82 (100); length of hinge line, ·56 (68); depth of ventral valve, ·24 (29).

This species, on casual observation, would be referred to *P. lacrymosa*, Hall, (x. Report New York Regents, p. 177.) The beak, however, is less acute and projecting, the ears less flattened, the dorsal valve less concave, and the ventral less produced. If possessed of cardinal spines it might be taken for *Chonetes truncata*, Hall. Figures D and Dd, Whittlesey, (Proc. Amer. Assoc. Cincinnati, p. 220,) may be intended for this species.

"Weymouth, Medina County, Ohio, 60 feet below the conglomerate." Whittlesey's Collection.

Producta concentrica, Hall. In quoting this species from Michigan, (Proc. Acad. Nat. Sci. Phil., Sept. 1862, p. 411,) it was stated that only the interior of dorsal valves had been seen in the southern part of the State. Since then I have obtained good ventral valves from Battle Creek, which agree in every respect with specimens from Burlington, Iowa.

A dorsal valve of this species was found at Rockford, Indiana, in the bluish argillaceous brecciated limestone of the famous "Goniatite bed." This species is now known to occur in Northern and Southern Michigan, at Burlington and Rockford, and probably in Missouri and Illinois.

The young of *P. concentrica*, *Shumardiana*, *pyxidata*, *Cooperensis* and *arcuata*, present resemblances so strong that it is scarcely possible to distinguish them from each other. In the adult state, however, the last may be distinguished by its much stronger and regular costæ, its less rapid expansion and greater arcuation. *P. Cooperensis* has the form of *P. arcuata*, without its strongly marked ribs. The other three species are not satisfactorily distinguishable, even in the adult state. *P. pyxidata* was described by Hall from the so-called Hamilton shale and limestone of Hamburgh, Ill., and Louisiana, Mo.; *P. Shumardiana* was described by Hall from the so-called Hamilton of Clarksville, Mo., and the so-called Chemung of Burlington; *P. concentrica* only from the latter locality. It is probable that the rocks at all of these localities are of nearly the same age. This being the case, the probability becomes strengthened that the three species first named are one and the same. If so, *P. concentrica*, having been first published, will displace the other two names.

Producta semireticulata, Fleming, (*P. Martini*, (De Kow) Win. Proc. Acad. Nat. Sci. Phil. Jan. 1863, p. 4; figs. B. and Bb, Whittlesey, Proc. Amer. Assoc. Cincinnati, p. 219.) This species occurs plentifully at Battle Creek, Michigan. Collected by A. Winchell. Also in Hillsdale County. Collected by Rev. J. D. Parker.

A large specimen from the sandstones at Burlington, Iowa, resembles, in its want of mesial sinus, the forms of *P. semireticulata* occurring in the Burlington limestone, rather than its associates in the same strata. It possesses in addition, a peculiar sharpness of the ribs not seen in other specimens.

Occurs also in Whittlesey's Collection from "Weymouth, Medina county, Ohio, 60 feet below the conglomerate;" and "Sheldon's sawmill, Orange, Cuyahoga county, below the grindstone grit."

P. Newberryi, Hall, (x. Rep. N. Y. Regents, p. 180,) from Ohio, is perhaps too closely related to this species. Dorsal valves cannot be distinguished from dorsal valves of *P. semireticulata*, as they occur at Battle Creek, Mich. The ventral valve of *P. Newberryi* does not become so much arcuate, the concentric wrinkling is a little more wavy, and less regular, the beak is less attenuate, and projects less beyond the hinge, and the mesial depression is smaller.

Not so

Producta Cooperensis, Swallow, (Trans. St. Louis Acad. Nat. Sci. i. 640.) The hinge line is shorter than in the typical specimens, but otherwise the agreement is good.

Bed "No. 1," Burlington, Iowa. "White Collection" of the University of Michigan.

Chonetes pulchella, Win., (Proc. Acad. Nat. Sci. Phila., Sept., 1862, p. 410). Collected by A. Winchell at Germain's and Alan's Quarries, Hillsdale, Michigan. One specimen from this locality is larger than usual, presenting a greater elongation of hinge line, which is drawn out at the extremities to an abrupt acumination. The number of ribs is about 60. Two cardinal spines are seen on each side of the beak, making an angle of about 60° with the hinge line.

See

Occurs also in Ohio, at "Howland, Trumbull County, one half mile east from Center, at "Warren, Trumbull County, in coarse bedded sandstone, next below the conglomerate," and at "Tallmadge, Summit County, in a boulder, supposed to be from the shales next below the conglomerate," Whittlesey's Collection.

C. pulchella, in the number of its ribs, is intermediate between *C. Logani*, Nor. and Prat. and *C. Illinoisensis*, Worthen. In this character it most resembles the former, while it differs from it in the smoothness of the ribs. It resembles *C. setigera*, Hall, and *C. nana*, but differs from the former in having oblique instead of erect spines, and from the latter in the smaller area of the ventral valve. *C. setigera* occurs in the Hamilton and Chemung of New York, and I have identified it in the blue argillaceous shales of the Huron group of Michigan. *C. nana* is found in the corniferous limestone; and European geologists regard it as a Devonian species.

CHONETES ILLINOISENSIS, Worthen, (Trans. St. Louis Acad. Nat. Sci. i. 571); *C. Logani*, Hall, (Iowa Rep. p. 598, pl. xii. fig. 1a—e and 2); not *C. Logani*, Norwood and Pratten, (Jour. Acad. Nat. Sci. Phil. [2] iii. 30, pl. ii. fig 12, a, b, c]; *C. Illinoisensis*, Winchell, (Proc. Acad. Nat. Sci. Phil., Jan., 1863, p. 5). This wide spread species occurs at the Grindstone quarries at Pt. aux Barques, Mich. The specimens are smaller than the typical ones from Burlington, Iowa, and perhaps for this reason do not number as many striæ around the margin; but specimens from Burlington of the same age cannot be distinguished.

Collected also by A. Winchell at Rockford, Indiana. It also occurs in the base of the Burlington limestone at Burlington, Iowa, ("White Collection") and in the fine grained sandstones of Licking County, Ohio.

This species may be confounded with *C. Shumardiana*, De Koninck; but the latter has 270 to 280 or more radiating striæ, which are less distinctly isolated from each other. The former has from 100 to 125 striæ.

Chonetes geniculata, White, (Proc. Bos. Soc. Nat. Hist. ix. 29). A single ventral valve, collected by A. Winchell at Rockford, Indiana, cannot be distinguished from this species.

CHONETES LOGANI, Norwood and Pratten. In a former paper I pointed out the error of Hall's identification of *C. Logani*, N. & P., though this species had not at that time fallen under my observation, and, I believe, has been seldom seen since first described. I have now, however, in some later additions to the "White Collection" of the University, a number of examples of *C. Logani*, N. & P., fully answering to the original description and figure. These specimens are from the base of the Burlington limestone, and the matrix holds *C. Illinoisensis* in the same association, as previously believed.

C. Logani, N. & P., as far as I have observed, is restricted to the horizon of the Marshall or Burlington sandstone—including the base of the Burlington limestone, which belongs evidently to the same epoch. Prof. Hall, however, has a small *Chonetes* from the Tully limestone, which, he informs me, he has decided to refer to *C. Logani*, (see 11th volume Palæontology of N. Y.), a reference to which, with full acknowledgement of his superior authority, I cannot, at present, give my assent. The Tully limestone species presents a series of concentric rugosities or wrinkles, which extend both across the ribs and the intervals between the ribs; while in *C. Logani* the rugosities are feebler, and are confined to the crests of the ribs.

C. Logani is also recognized in Ohio, with about 40 to 50 ribs. It hence appears that the species, like *C. Illinoisensis*, Worthen, and *C. multicosta*, Winchell, ranges from the Burlington limestone into the sandstone below.

I may perhaps be permitted to add that some typical specimens of *C. Logani* in Prof. Hall's cabinet, sent to him by Dr. Norwood, are imbedded in a matrix of oölitic limestone, such as occurs at the base of the Burlington limestone.

ORTHIS MICHELINI, L'Evéillé, occurs in Whittlesey's collection from "Waverly sandstone, near Newark, Licking County, Ohio." Another *Orthis* from Akron, Ohio, resembles the Burlington species commonly referred to *O. Vanuxemi* (?), but differs in the parallel direction of the dental lamellæ, and in the very indistinct character of the radial striation.

Still another *Orthis*, received from Dr. Shumard and collected at Sulphur Springs, St. Louis County, Missouri, is perhaps the species referred by the

Missouri geologists to *O. Michelini* (?). It is a small circular species, with extremely fine ribs or striæ, apparently too obscure for either *O. Michelini* or *O. Vanuxemi.*

Orthis flava, n. sp. Shell small, transversely oval, slightly truncate on the cardinal side. Ventral valve convex, perceptibly flattened toward the anterior margin, though without a marked sinus; most elevated near the slightly projecting beak; area rather high and broad, triangular, with an equilaterally triangular foramen; dental lamellæ slender, short, diverging at an angle of about 80°; occlusor scars small, together enclosing a longitudinally oval space, which reaches one-third the distance from the beak to the anterior margin; a median internal ridge reaches from the beak to beyond the middle of the valve. The shell was evidently thin; its surface marked by one hundred or more delicate radiating ribs, which increase by implantation.

Transverse diameter of shell ·50 (100); longitudinal diameter ·39 (78); depth of ventral valve .12 (24).

Burlington, Iowa, apparently from Bed "No. 1." at the base of the yellow sandstones. "White Collection," of the University of Michigan.

This species is less circular than the forms referred to *O. Michelini*, and has a more convex ventral valve and larger area. It differs from *O. impressa*, Hall, (Geol. Rep. 11th Dist. N. Y., p. 267, fig. 2), in its more transverse shape, smaller size, more convex ventral valve, and feebler sinus.

Streptorhynchus lens? White, (Proc. Bos. Soc. Nat. Hist. ix. 28), "Weymouth, Medina County, Ohio, 80 feet below the conglomerate." Whittlesey's Collection.

Streptorhynchus umbraculum? Schloth. sp. From "coarse bedded sandstone, next below conglomerate, Warren, Trumbull County, Ohio." Whittlesey's Collection.

A large, undetermined species from oölitic limestone, "No. 6," Burlington, Iowa, probably belongs here. Collected by A. Winchell.

Streptorhynchus inequalis, White sp. From Weymouth, Medina County, Ohio, 80 feet below conglomerate." Whittlesey's Collection.

Streptorhynchus ——— sp.? A single interior of a ventral valve from "near Ashland, Ashland County, Ohio," resembles *S. Chemungensis*, var. *pectinacea*, Hall. (Pal. N. Y., Vol. iv.) It differs, however, in the possession of a longer hinge line, and distinct auriculations, and lacks the alternation in the size of the radial ridges.

Pentamerus lenticularis, White and Whitfield. This species, described from the yellow sandstone of Burlington, occurs also in the base of the Burlington limestone. "White Collection" of the University of Michigan.

SPIRIGERA, D'Orbigny.

Spirigera Missouriensis, n. sp. Shell of moderate size, broadly ovate, moderately ventricose, with lamellose exterior. Ventral valve with an extended beak, turned up at right angles with the plane of the shell, and having a circular perforation at its extremity. Between the beak and the dorsal valve is an external flattening simulating an area, but traversed by the incremental lines. Sinus a shallow but distinct groove, beginning at the beak, widening and deepening anterior to the middle, and near the middle becoming well characterized. Dorsal valve nearly circular, with straight hinge slopes, and obtuse beak closely incurved and concealed, though not in contact with the ventral beak. Mesial fold less distinct than the sinus of the ventral valve, arising near the middle of the valve. Both valves are marked by numerous strongly imbricating lamellæ of growth. Greatest thickness through the middle of the ventral valve.

Length ·69 (100); width ·65 (94); thickness of both valves ·41 (59).

From the Lithographic limestone of Louisiana, Missouri. White Collection of the University of Michigan. Also from the sandstone at Weymouth, Medina County, Ohio, 60 feet below the conglomerate. Whittlesey's Collection.

Close observation is necessary to distinguish this species from *S. subtilita*, Hall. That species, however, is less lamellose, the ventral sinus does not extend above the middle of the shell, and the flattening beneath the beaks of the ventral valve is wanting.

Spirigera biloba, n. sp. Shell broadly ovate in outline. Ventral valve rather ventricose, with a prominent beak which is gradually recurved, and apparently minutely perforate at apex. A deep, narrow, median furrow begins at the apex and extends to the anterior margin; from the bottom of this the surface rises with a convex curvature to the summits of the two rounded ridges which constitute the most prominent portion of the valve; from these summits the curvatures continue to the right and left margins, which are thus rendered quite obtuse. The external surface is marked only by a few faint incremental lines. Shell structure fibrous. Characters of dorsal valve unknown.

Length ·16; breadth ·16.

Collected by A. Winchell in the Goniatite limestone at Rockford, Indiana.

This shell has somewhat the aspect of a *Centronella* or *Terebratula*, but its structure is not punctate. The unique character of the mesial furrow distinguishes it from any known species of *Spirigera*.

Spirigera Ohiensis, n sp., (Figs. A and Aa, Whittlesey, Proceedings Amer. Assoc. Cincinnati, p. 220). Shell large, subcircular in outline, moderately ventricose. Ventral valve regularly arched from beak to anterior margin, having the cardinal slopes somewhat straight, and the lateral margins considerably compressed. Sinus shallow and broad, extending half way to the beak. Surface marked by numerous delicate, subequidistant, rigid, concentric striæ.

Length 1·18; breadth 1·40.

Akron, Ohio, 50 feet below the conglomerate. Whittlesey's Collection.

This species differs from *S. Hannibalensis*, Swallow, in its less ventricosity, especially around the margin, and in the absence of concentric lamellæ; it differs from *S. Missouriensis*, Win., in its transverse form, more compressed lateral margins, and its numerous and regular concentric striæ. In the last character it resembles *S. concentrica*, but the mesial sinus (and probably fold) is much less marked.

Spirigera Hannibalensis, Swallow, occurs in the Lithographic limestone at Clarksville, Missouri. White Collection of University of Michigan.

SPIRIFERA, Sowerby.

Spirifera centronata, n. sp. Shell of medium size, with an elongate, cuspidate hinge margin, and, aside from the cardinal extremities, a somewhat semicircular general outline. Ventral valve of medium fulness near the umbo, somewhat depressed between there and the margins; beak elevated above the cardinal line more than one-fifth the whole length of the valve, incurved and overhanging a very narrow area. A distinct and comparatively deep sinus begins at the extremity of the beak, very gradually widening and becoming ill-defined in the middle of the valve and beyond. External surface marked by 36 to 40 ribs, of which from three to five fall in the mesial sinus. The ribs disappear on the alate cardinal expansions. One or two concentric furrows marking the middle region of the valve.

Length along cardinal line, 1·23 (100); length from beak to anterior margin, ·52 (42); greatest convexity of ventral valve, ·11 (9).

Museum of the University of Michigan. Collected by A. Winchell, at Cuyahoga Falls, Ohio, in the flagstones below the conglomerate. Occurs also in Col. Whittlesey's collection from Akron, Ohio, 50 feet below the conglomerate.

This species is distinguished from all other spirifers by the association of cuspidate hinge extremities with a ribbed mesial sinus, and semicircular front margin. When the cuspidations are removed, the shell recalls *S. Marionensis*, Shumard, from the so-called Chemung of Missouri and Iowa; and, in all except the semicircular outline it corresponds with *S. cuspidatus*, Hall, (not of Martin,) from the Chemung of New York.

SPIRIFERA SILLANA, n. sp. Shell transverse, broadest at about the middle; anterior margin somewhat straight; ends rounded anteriorly, sub-truncate from the extremity of the greatest diameter to the cardinal side. Dorsal valve of medium convexity, arched regularly from beak to anterior margin; beak but slightly elevated above the hinge, incurved; area narrow. A well defined mesial fold extends from the beak to the front margin, rising abruptly from the general surface, and arching regularly over. The fold is marked only by incremental lines, save a faint indication of two radial ribs in the vicinity of the umbo; the other portions of the external surface are marked by one or two imbricating lamellæ of growth, and regularly formed ribs which radiate without increase in number, from the beak; eighteen or twenty of these can be distinguished on each side of the mesial fold.

Greatest transverse length, 2·1; length from beak to anterior margin, 1·05; greatest convexity of dorsal valve, ·20; width of mesial fold at anterior margin, ·45.

This species is readily distinguished by having an elongate form, without having its greatest length along the hinge line.

Collected by A. Winchell, at Valley Forge, one and a half miles below Cuyahoga Falls, Ohio, in fine ferruginous sandstone underlying the conglomerate. Museum of the University of Michigan.

Named in honor of Judge E. N. Sill, of Cuyahoga Falls, in acknowledgment of facilities afforded the writer in the examination of the rocks of his vicinity.

SPIRIFERA EXTENUATA, Hall. This Burlington species occurs at Battle Creek, Calhoun county, and Germain's quarry, Hillsdale county, Michigan. Collected by A. Winchell.

SPIRIFERA HIRTA ? White and Whitfield. A ventral valve of a spirifer differing from the above only in the absence of all trace of a mesial sinus, and in its somewhat fainter radial lines.

Bed "No. 6," Burlington, Iowa, while the typical specimens seem to come from Bed "No. 1." "White Collection" of the University of Michigan.

SPIRIFERA VERNONENSIS, Swallow, 1860. (Trans. St. Louis Acad. Sci. i. 644.) A specimen labelled as above by Dr. B. F. Shumard, from Sulphur Springs, St. Louis county, Missouri, too strongly resembles *S. Carteri*, Hall, 1858, (xth Rep. N. Y. Regents, p. 170,) judging by a specimen of the latter from Cuyahoga Falls, Ohio, which Prof. Hall admitted to be *S. Carteri*. Coll. A. W.

SYRINGOTHYRIS HALLI, Win. This peculiar form occurs at Battle Creek, Michigan. Collected by A. Winchell.

SPIRIFERINA, d'Orbigny.

SPIRIFERINA CLARKSVILLENSIS, n. sp. Shell small, transverse, semielliptic, with coarse plications. Ventral valve rather ventricose, most elevated toward the beak, regularly arched from beak to anterior margin; beak broad, projecting much beyond the hinge, strongly recurved; hinge line nearly as long as the greatest width of the shell, forming a rounded right angle with the short lateral margins; area triangular, three and a half times as long as high, arched in the quadrant of a cylinder, striated in both directions, pierced by a foramen reaching to the very apex of the beak, nearly twice as high as broad, rounded at its upper angle. Mesial sinus deep, broad, regular, beginning at the apex of the beak, the bounding ribs forming with each other an angle of about 22°; on each side of the sinus five large plications, of which only the first three reach the beak, the others terminating at the area; these are crossed by sharp, neat, imbricating lamellæ of growth, of which, in the middle of the valve, about four occur in one-tenth of an inch. Dental plates short, columnar; a median internal septum reaching from a point a little posterior to the teeth, as far as the middle of the valve, thick at the bottom, thinned to an edge above. Internal surface of valve marked with numerous indented punctations. Dorsal valve unknown.

Length, ·48 (71); breadth, ·68 (100); length of hinge line, ·52 (79); height of area, ·15 (22); convexity of ventral valve, ·22 (33).

From the Lithographic limestone, Clarksville, Missouri. "White Collection" of the University of Michigan.

This species bears perhaps too close a resemblance to *S. solidirostris*, White. The single valve, however, on which the species is founded, is more convex, with more rounded ribs, less regular lamellæ, a higher area and more incurved beak. This is the specimen referred to by White, (Boston Proc. ix. 25,) and doubtfully identified with *S. subtexta*, White—a Burlington limestone species.

Spiriferina binacuta, n. sp. Shell of moderate size, transverse, with numerous rounded ribs and attenuate hinge extremities. Dorsal valve somewhat ventricose in the middle, regularly arched from anterior margin to the beak, becoming depressed toward the lateral extremities. Hinge line elongate, thickened at the margin, abruptly acuminate. Area narrow and long. Mesial fold little elevated above the general surface, divided by a furrow into two ribs, which, in old specimens, are again divided; ten or eleven rounded ribs on each side of the mesial fold, of which the last two or three are subobsolete. External surface finely and regularly lamellose. Substance of shell thin and apparently possessing a rather coarsely punctate structure.

Length of hinge line, ·78; length from beak to base, ·30.

This species is readily distinguished by its auricular acuminations and plicate mesial fold.

From the base of the Burlington limestone. "White Collection" of the University of Michigan.

Spiriferina solidirostris, White. From near Hamburg, Illinois. "White Collection." The ribs are more rounded than in the specimens from the Burlington sandstone. The same species occurs associated with *S. binacuta* in the base of the Burlington limestone.

RHYNCHONELLA, Fischer de Waldheim.

Rhynchonella? tetraptyx, n. sp. Shell minute, subcircular in outline, with few and deep plications. Ventral valve moderately convex, highest in the middle, with a straight projecting beak, which is circularly perforate at apex, with a triangular opening below to the hinge. Along the middle of this valve is a very deep and very narrow sinus reaching nearly to the beak, and bounded by a very prominent rib on each side, beyond which is another smaller rib, making four in all. Dorsal valve almost strictly circular, with the same convexity as the ventral, highest also in the middle, with the inconspicuous beak closely appressed, and the middle raised into a strong plication or rib corresponding to the sinus or furrow of the ventral valve; on each side of this rib is another strong one, and still beyond, a very feeble one. None of the shell being preserved, no revelations are made of the minute structure.

Length, ·17 (100); breadth, ·15 (88); thickness, ·09 (53).

Collected by A. Winchell, at Rockford, Indiana.

The straight beak of the ventral valve, and the general aspect of the shell, render the above generic reference unsatisfactory. Externally it seems to have some relations with *Trematospira* and *Leptocœlia*, of Hall, while it still more strikingly resembles *Spirifer Buchianus*, de Kow, (Anim. Foss. pl. xv. bis fig. 3, and xix. fig. 6;) but until its internal characters are known, I leave it where it stands.

Rhynchonella heteropsis, n. sp. Shell small, varying from sectoriform to transversely elliptic, with moderately projecting beak; very young specimens in the shape of a barley-corn. Plications sharp, ranging in number from ten to twenty; of which three generally (sometimes two or four,) occupy the sinus of the ventral valve. This valve has a moderately sharp beak, turned back in an angle of 45° with the plane of the shell, and slit (in the cast) from the apex to the hinge; sinus deep toward the front of the mature shell, wanting in the young one; the plications on each side of the sinus variable; four in those with two plications in the sinus, six, seven or eight in those with three, and five in those with four, making the whole number of plications ten to nineteen. These lateral plications are bent backwards in approaching the margin. Greatest prominence of ventral valve near the beak. Dorsal valve more ventricose than the ventral, most prominent at the anterior margin; mesial fold much less marked than the sinus opposite, consisting of two, three, four or five plications, elevated at their extremities somewhat above the lateral plications, the remotest of which exhibit a strong downward curvature. Beak of this valve concealed beneath that of its fellow.

Length, ·38 (90); breadth, ·42 (100); thickness of both valves, ·28 (67).

From one of the calcareous beds, "No. 4," of the yellow sandstone, Burlington. "White Collection" of the University of Michigan. Also near Hamburg, Illinois, and at Weymouth, Medina county, Ohio. Whittlesey's Collection.

I had hoped that these varying forms could be brought under one of the numerous species already described from this group. It is a much smaller shell, with more abrupt sinus than *R. pustulosa*, White, from the same locality. It is about the size of *R. camerifera*, Win., from Pt. aux Barques, but, besides wanting the long dental and median plates of that species, the sinus and fold are much more strongly marked, and the transverse diameter is relatively greater, giving the rostral region less relative prominence; and the mean number of plications is considerably less. In the rostral region it differs from *R. Sageriana*, Win., in the same manner, besides being a smaller shell with shallower sinus.

Rhynchonella persinuata, n. sp. Shell of medium size, transversely oval, with abbreviated rostral extension. Cardinal slopes nearly straight, sides rounded, front straight. Ventral valve depressed, with about twenty straight plications, of which eight occupy the broad and rather shallow sinus. Anterior margin of valve abruptly deflected. Dental lamellæ extending nearly one-third the length of the valve. The beak of this valve projects nearly in the plane of the shell, and the lateral portions of the valve are continued, without convexity, to the borders, thus giving this valve a peculiarly flattened surface—the broad sinus forming a similar plane lying at a lower level.

Transverse diameter, ·67 (100); length, ·52 (77); thickness of ventral valve, ·16 (24).

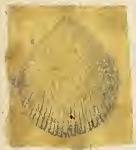
Burlington, Iowa, in the yellow sandstone. "White Collection" of the University of Michigan.

This shell suggests *Terebratula pleurodon*, variety *polyodonta*, Phillips, (Geol. Yorks, pl. ii. p. 222, pl. xii. fig. 27.) It is a smaller species than that, with a shallower sinus and an abruptly deflected margin.

Rhynchonella unica, n. sp. Shell minute, longitudinally ovate in outline, the sides and front equally rounded, the cardinal slopes somewhat straight and the beak acute. The peculiarity consists in the arrangement of the median plications of the two valves. In the middle of the ventral valve are five sharp plications which extend to the beak; the two outer of these are very prominent, projecting above the general surface like vertical laminæ; the middle three are anteriorly depressed considerably below the general surface, and constitute the mesial sinus, which extends to the middle of the valve, and thence rises above the general surface to the level of the two outer plications. On each side of the median plications are four others, which, instead of converging toward the beak in conformity with the median ones, converge toward an imaginary point some distance in front of the beak, in consequence of which the posterior extremities of two or three are overlapped by the median set. In the dorsal valve four median plications rise in an elevated band and attain an equal elevation near the front of the valve, but posteriorly, the two middle ones of the four sink below the level of the others, and are lost from sight before reaching the beak. In consequence of these arrangements, the ventral valve presents a sinus anteriorly and an elevation posteriorly; while the dorsal valve presents an elevation anteriorly and a sinus posteriorly. The two valves are about equally convex. The beak of the ventral valve projects in a tubular form slightly beyond that of the dorsal, and exhibits a circular perforation of the extremity.

Length, ·24 (100); breadth, ·19 (79); thickness of both valves, ·15 (62).

From Bed "No. 4," Burlington, Iowa. "White Collection" of the University of Michigan.



Ret. micropleura,
Winchell

Rhynchonella (Retzia?) micropleura, n. sp. Shell of medium size, Retzia-like externally. Ventral valve ovate, somewhat produced rostrally, with rather straight lateral margins, and a semi-circular anterior margin; most tumid near the beak, slightly flattened anteriorly; beak somewhat incurved; mesial sinus wanting or represented only by a slight flattening of the anterior portion; surface with two or three varices of growth, and about 50 rigid, continuous, rounded, radiating ribs, which are separated by narrower spaces.

Length of ventral valve, ·59 (100); width, ·48 (81); convexity, ·15 (25).

Collected by A. Winchell, at Battle Creek, Michigan.

It much resembles *Retzia polypleura*, Win., of the Huron group, but the beak is less prolonged and less straight, and the width of the shell is greater. I know of no *Rhynchonella* which like this is without a sinus, and so finely ribbed at the same time. In the first of these characters it is approached by *R. Hubbardi* and *R. Sageriana*, from the same rocks.

See R. polypleura, on p 406

Rhynchonella Hubbardi, Win. This species originally described from Marshall and Pt. aux Barques, Michigan, has since been found by the writer at Napoleon Cut in Jackson county; and also rather plentifully in some of the thin layers of sandstone at Valley Forge, near Cuyahoga Falls, Ohio. It occurs also at Talmadge, Summit county, Ohio, in beds next below the conglomerate. Whittlesey's collection.

Rhynchonella Sageriana, Win. Identified in Whittlesey's collection from Weymouth, Medina county; near Ashland, Ashland county; Drew's sawmill, Big Brook, Orange, Cuyahoga county, and two miles southwest of Northfield Centre, Summit county, Ohio.

R. Sageriana has remote relations to some of the forms of *R. pleurodon*, Phillips. Compare var. *Devreuxiana*, De Kon. (Davidson's Mono. Brit. Carb.

Brach. pl. xxiii. fig. 19–21.) The ribs, however, are more numerous, and the frontal commissure more deeply sinuate.

CENTRONELLA, Billings.

Centronella Allei, n. sp. Shell large to medium size, terebratuliform, greatest width a little anterior to the middle, contained one and one fourth times in the greatest length. Ventral valve somewhat ventricose, full to the immediate vicinity of the margin, especially along the cardinal slopes; regularly arching from beak to anterior margin, highest in the middle; anterior margin with a barely perceptible truncation; no sinus or fold present; beak produced beyond that of the dorsal valve, truncated and circularly perforate at the extremity; dental lamellæ more than one-fifth the whole length of the valve; muscular scars, consisting of one faint median linear impression, on each side of which is another, all reaching to the middle of the valve. Dorsal valve with its short imperforate beak closely concealed under that of its fellow, slightly truncate in front, but without mesial fold or sinus; regularly arched from beak to front, highest in the middle, exhibiting a convexity equal to that of the opposite valve. Muscular scars consisting of a faint but distinct linear median impression, with a much deeper linear impression on each side, and a very faint one exterior to each of these—the three principal impressions reaching to the middle of the valve. Shell thin, stony and solid; structure beautifully punctate under a lens; general surface polished, marked by a few feeble concentric lines of growth.

Length of ventral valve, ·66 (100); breadth, ·41 (62); convexity, ·19 (29).

The dorsal valve above referred to comes from bed "No. 6," at Burlington; the other specimens are apparently from "No. 5." "White collection" of the University of Michigan. Also near Hamburg, Illinois, and at Talmadge, Summit county, Ohio. Whittlesey's collection.

Though the peculiar loop of *Centronella* has not been seen in these specimens, the characters given are so closely conformable with that genus that the reference can scarcely be questioned in the present state of our knowledge. It is a larger, more ventricose and more elongated shell than *C. Julia*.

C. Julia W. from Winchells drawing

Centronella Julia, Win. A single small specimen of this northern species occurs in Whittlesey's Collection, from "one mile east of Orange Center, Cuyahoga county, Ohio."

See p. 405 description

Specimens of this species from Pt. aux Barques, have been employed by Prof. Hall to illustrate the characters of his genus *Cryptonella*, (Trans. Albany Inst. Feb. 3, 1863, p. 4; reprinted Amer. Jour. Sci. [2] xxxv. 399.) The reference of this species to *Centronella* was made solely in the light of Billings' description and figure of that genus and comparisons with the internal structure of *Centronella glansfagea*, the type of the genus. Prof. Hall asserts that the description and figure do not bear out the reference; and, having previously founded *Cryptonella* on the external characters of certain terebratuliform species, he assumes that *Centronella Julia* affords an exhibition of the internal characters of *Cryptonella*. There is not the least doubt that the original reference of *Centronella Julia* was correct; and since its internal characters are assumed by Prof. Hall as being those of *Cryptonella*, the latter genus is thus admitted by its author to cover the same ground as the older genus *Centronella*, and must consequently pass out of use. Prof. Hall seems to have suspected this result; for in a note interpolated in the New Haven edition of his paper, (p. 405,) he refers to a drawing of a specimen of *C. glansfagea*, showing the loop, (sent him by Dr. Rominger of Ann Arbor,) and admits that the loop "shows essentially the same character as that of *Cryptonella*." He yet insists that this character is not to be inferred from Billings' original description and figure; and, expressing a doubt about the identity of Billings' type species (*C. glansfagea*) and the one figured by Rominger, "hesitates to unite" *Cryptonella* and *Centronella* "until a reëxamination of the original specimens of Mr. Billings shall confirm his first observations, or show them to correspond with" *Cryptonella.* It is this hesitation to admit the inevitable consequence, and to retract his honorable and friendly, but unfounded criticism, which induces me to reassert the correctness of my generic reference of *Centronella Julia*, resting as it does upon the original description and figure, and the observed characters of the type of the genus, as well as the subsequent confirmation of the author of the genus, himself.

OSTREA, Linnæus.

Ostrea patercula, n. sp. Shell adherent, thin, small, ovate, deeply boat-shaped, with the deeply excavated beak of the lower valve prominent, incurved and somewhat posterior. The muscular scar is large, transversely broad-reniform, concave on the cardinal side, situated nearly midway between the centre of the valve and its posterior margin, and is marked by two transverse lamellose lines. The deepest part of the valve is midway between the centre and the beak; the depth is nearly the same for as great a distance on the other side of the centre. The exterior of the shell is irregular with concentric lamellose lines of growth.

Greatest length, ·65 (100); greatest width, ·40 (61); greatest depth of lower valve, ·25 (35); depth of cavity of the beak, ·15 (23).

From the buff sandstone at the base of the Burlington limestone, Burlington, Iowa. "White Collection" of the University of Michigan.

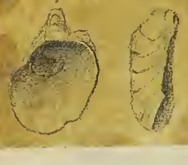
The unexpected discovery of this oyster—believed to be the most ancient at present known—together with its somewhat cretaceous aspect, awakened a suspicion that it had not been found in place. To certify myself on this point, I addressed Dr. White on the subject, and received the following reply: "The *Ostrea*, if I remember rightly, was imbedded in a white or light gray, silicious material, of chalky appearance, *containing some remains of crinoids* and shells. My impression is, also, that it was from a quarry about half a mile north of my residence, and in the lower bed of the Burlington limestone, and not far from its base. I think the label which accompanied it, and also my letter at the time, may be entirely relied on. I admit the possibility of error, but I do not believe there is any."

Pterinea crenistriata, Win. (*Cardiopsis crenistriata*, Win., Proc. Acad. Nat. Sci. Phil. Sept. 1862, p. 417.) More perfect specimens from the typical locality of *C. crenistriata* reveal the fact that the species is possessed of an anterior wing, which is a mere flattened portion of the anterior angle of the cardinal line, with a barely perceptible sinus beneath. This feature does not belong to *Cardiopsis* as defined, and establishes a probable conformity with *Pterinea.*

The right valves—recently discovered—might be mistaken for another species. They show no radiating lines, except near the hinge, behind the beak. The concentric markings are only small, irregular wrinkles of growth, with none of the sharply raised lines which characterize the other valve. It is of course possible that these right valves belong to another species, but as they have exactly the form of the crenistriated valves, and the latter are all left valves, it seems probable that they belong together.

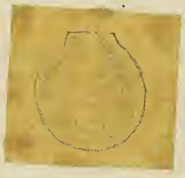
Pterinea spinalata, n. sp. (*Avicula acanthoptera*, Win., Proc. Acad. Nat. Sci. Jan. 1863, p. 8; *not A. acanthoptera*, Hall, Geol. Rep. 10th Dist. N. Y. p. 263.) Careful comparison with the types of *A. acanthoptera*, Hall, convinces me that the Iowa specimens ought to be separated. The left valve of *A. acanthoptera*, Hall, has the body of the shell broader than in the Iowa specimens, and both wings are less defined. The right valves, also, are much flatter.

Amongst the Iowa specimens appear to be two types—one with the body of the valve arcuate, and the other with it straight. The former type was



O. paterculа. W

From Winchell's drawing of the type.



From a drawing of
Prof. Winchell's, marked
Av. Cooperensis, Shumard

adopted for the specific description, (see the paper referred to.) The latter may constitute the type of still another species.

The species described as *Avicula Whitei*, Win., and *Gervillia strigosa*, White and Whitfield, should probably be referred to *Pterinea* in accordance with views recently put forth by Mr. Meek.

Aviculopecten Caroli, Win. This species first described from the yellow sandstone at Burlington, Iowa, is found also in the base of the Burlington limestone at the same locality. "White Collection."

Aviculopecten tenuicostus, Win. A very small specimen, collected by A. Winchell, at Rockford, Indiana, seems to agree with the above Burlington species.

Other specimens collected at Germain's quarry, Hillsdale, Michigan, have the same proportions and general surface characters, but they are once and a half as large as the Burlington types, and the anterior auriculation is marked by coarser, instead of finer striæ. The body of the shell presents about 57 striæ and the anterior ear 8.

The foreign analogue of this species seems to be *Pecten arenosus*, Phillips.

PERNOPECTEN, new genus.

Etymology.—Perna and Pecten, from a combination of some of the characters of the two genera.

Generic Characters.—Shell bivalve, sub-equivalve, monomyary. Valves more or less inequilateral and auriculate. Hinge line straight; hinge furnished with a central, triangular cartilage pit, and a transverse plate bearing on each side of the middle a series of smaller pits diminishing in size and depth from the centre outwards. The shell seems to be thin, and probably has a structure more like *Pecten* than *Perna*.

This genus, or subgenus is founded on *Aviculopecten limæformis*, White and Whitfield, (Proc. Bos. Soc. Nat. Hist. vol. viii. p. 295.) My attention was first directed to the peculiarity of the hinge structure in two or three specimens sent me by Dr. White himself; and an examination of a number of specimens previously referred to this species shows that they all possess it. The genus *Aviculopecten*, happily constituted by McCoy to receive a number of paleozoic species having affinities with *Pecten* in their external form, and with *Avicula* in their cardinal structure, is made by its author to differ from *Pecten* by the absence of a central ligamentary pit, and from *Avicula* by its nearly equilateral outline. The present genus differs from *Avicula* and *Aviculopecten*, and approaches *Pecten* and *Monotis*, in the presence of a mesial ligamentary pit; and it differs equally from *Pecten*, *Aviculopecten* and *Avicula*, and approaches *Perna*, by the presence of a series of isolated ligamentary pits in the cardinal area. It differs from *Perna* in its sub-central beaks, with ligamentary pits on both sides. It agrees with *Amusium* in its sub-symmetrical ears, central cartilage pit, and the absence of radiating ridges, but differs in its straight hinge line and lateral cartilage pits. The position of the genus is apparently between *Perna* and *Pecten*, with a preponderance of affinities for the latter, sufficient, perhaps, to throw it into the family of *Pectinidæ*, Whi~~t~~e. *Aviculopecten* is grouped with the *Aviculidæ*.

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It is probable that in addition to the two following species, others referred to *Avicula*, *Pterinea*, and more especially *Aviculopecten*, *Amusium* and *Pecten*, will be found to possess the assemblage of characters shown in *Pernopecten* *Lima ? obsoleta*, Hall, (Rep. 10th Dist. N. Y., p. 265,) =*Pecten subobsoletus*, d'Orb., is stated to have a "crenulated hinge line," while its external characters are quite conformable to *Pernopecten*. Not improbably *Lima glaber*, Hall, belongs in the same association. The same may be said of *Pecten densistria*, Sandb., from the *Posidonomyenschiefer* of Nassau; *Avicula tumida* and

Avicula lævigata, de Koninck, from the carboniferous limestone of Belgium, &c. &c.

This genus is known to have existed in the Chemung of Phillipsburg, New York,* whence it probably continued to the epoch of the Burlington limestone. An undescribed species occurs in the fine grained sandstone of Ohio.

Pernopecten limæformis, Winchell. (*Aviculopecten limæformis*, White and Whitfield.) In this typical species, the number of ligamentary pits is about seven on each side of the mesial one. The hinge line is short, and the auriculations are small and Lima-like.

See written leaf [illegible] facing p. 255

Pernopecten limatus, n. sp. Shell rather small, moderately ventricose, subcircular. Body of shell bounded by two straight lines diverging from the beak at an angle of 126°, and proceeding to the superior lateral margins, from which points the outline of the shell is very nearly circular. Hinge line straight, a little more than one-third the greatest width of the shell; ears very small, flattened, subequal; the anterior (of the left valve) making an angle of about 106° with the hinge line, and 120° with the body of the valve; the posterior ear forming an angle of 129° with the hinge line and 146° with the body of the shell. Beak small, inconspicuous, not projecting beyond the hinge line. Convexity of the valve nearly a segment of a sphere, a little more elevated in the umbonal region. Surface extremely smooth.

Dimensions parallel with the hinge 1·20; at right angles with the hinge 1·05; length of hinge line ·40; length of anterior slope of body of valve ·59; of posterior slope ·47; convexity of left valve ·17.

From the base of the Burlington limestone, Burlington, Iowa, a horizon identified by its fauna with the yellow sandstones below, (compare my paper, Proc. Acad. Nat. Sci. Phila., Jan., 1863, p. 25). "White Collection" of the University of Michigan.

The internal hinge structure of this species has not been observed, but the auriculations are scarcely such as belong to *Aviculopecten*, as defined by McCoy, while they present a close conformity with the foregoing species.

Aviculopecten occidentalis, Win., differs from this in its longer cardinal slopes, making a smaller angle with each other, and in its longer hinge line, with larger and distinctly ribbed auriculations.

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Pernopecten Shumardanus, Winchell, (*Avicula circulus*, Hall, not Shumard). It is scarcely possible that the species identified by Hall (Iowa Rep. 522, pl. vii. fig. 9) as *A. circulus*, Shum., (Missouri Rep. 206, pl. c. fig. 14), can be the same species. Prof. Hall's figure and description do not show it; nor do specimens from the same bed, commonly regarded as *A. circulus*, Hall, present satisfactory correspondence. The shell has a much shorter hinge line, with smaller ears, joining the cardinal slopes by obtuse angles. Moreover the concentric lines are very regular, and the radial ones are faint, irregular dashes, entirely unlike the continuous and distinct though diminutive ribs of *A. circulus*, Shumard. See p. 254

Yielding to the suggestion of Dr. White, I formerly identified *A. circulus*, Hall—before I had seen actual specimens—with *Aviculopecten limæformis*, White and Whitfield. I am convinced, however, on careful comparison of specimens, that we must regard *A. circulus*, Hall, as a distinct species. ([illegible]

In general characters this species resembles *P. limatus*, and only differs in its shorter and less sharply defined cardinal slopes, and the presence of the two systems of superficial markings.

PINNA, Linnæus.

Pinna ? Marshallensis, n. sp. Shell small, equivalve, compressed, lanceolate, squarely truncate and gaping at the extremity opposite the hinge, and

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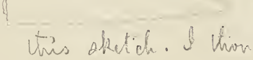
* I find that Prof. Hall has also marked this form as a distinct genus.

In Prof. Winchell's drawings of this shell presented the outline of



this sketch. I thought the specimen broken at the posterior end.

I still believe this to be the A. Cooperensis of Shumard.

acuminately tapering toward the opposite extremity. Anterior side nearly straight, or distinctly hollowed. Posterior side parallel with the anterior for half its length; toward the hinge gradually approaching the opposite side. The truncation is at right angles with the anterior side, leaving a broadly gaping ventral margin. External surface smooth.

Length dorso-ventrally ·97 (100); greatest dimension at right angles with this ·26 (27); thickness of both valves ·12 (12).

Collected by A. Winchell at Napoleon cut, Jackson County, Michigan.

MYALINA, De Koninck.

9/ Myalina Iowensis, n. sp. Shell rather small, ventricose, obliquely elongate-quadrate. Umbonal ridge elevated, arched, highest about midway between the beak and the opposite end, forming an angle of 50° with the straight, somewhat elongate hinge line; anterior and posterior sides parallel, the former distended in a very shallow pouch just beneath the beak, the latter very slightly hollowed throughout its upper half; basal region regularly rounded, with an obtuse angulation next the posterior side. From the umbonal ridge the slope is precipitous to the anterior margin, much less so toward the posterior, and it gradually subsides into a flattening toward the dorso-lateral angle. Surface of shell nearly smooth, marked with fine incremental lines.

Greatest dimension—from beak to opposite extremity—·83 (100); length of hinge line ·46 (55); diameter, at right angles with umbonal ridge, ·41 (50).

From the base of the Burlington limestone. "White Collection," of the University of Michigan.

This species resembles *M. angulata*, Meek and Worthen, from the Chester limestone of Illinois, and *M. Michiganensis*, Winchell, from the Marshall group of Michigan. From the former it differs greatly in its smaller size, its shallower posterior concavity, and its less abruptly rounded base. From the latter it differs in having straighter anterior and posterior sides, giving it a more quadrate outline, a more elevated umbonal ridge, and a shorter antero-posterior dimension.

Myalina Michiganensis, Win. Collected by A. Winchell at Napoleon Cut, Jackson County, and at Germain's Quarry, Hillsdale, Hillsdale County, Mich.

Edmondia ? bicarinata, Win. A species apparently identical with this occurs in a conglomerate four miles north of Panama, Chataque County, New York, supposed by Prof. Hall, in his Report on the Fourth District of New York, to constitute a portion of the Millstone Grit of Pennsylvania. It was figured and briefly characterized under the name of *Cypricardia contracta*, Hall. The later specific name must therefore be abandoned.

Edmondia æquimarginalis, Win. Specimens clearly identical with this occur in the same conglomerate with the above, as also in a conglomerate at another locality, supposed by Prof. Hall to underlie the Millstone Grit, and to constitute the terminal member of the Chemung Group. p. 13

The specimens of these two species occurring in New York, as well as the two others to be mentioned, are preserved in Prof. Hall's cabinet; and I desire to acknowledge my great obligations for the opportunity afforded of making the direct comparisons.

Edmondia Burlingtonensis ? White and Whitfield. A lamellibranch, too imperfect for certain determination, but closely resembling the above, occurs in Whittlesey's Collection, from a place "one mile east of Orange Center, Cuyahoga County, Ohio, 25 or 30 feet below the Grindstone Grit."

SANGUINOLITES, McCoy.

Sanguinolites strigatus, n. sp. A small species, resembling *Arca modesta* Win., from Burlington, Iowa. Unfortunately the specimen was lost while awaiting a description. It had, however, been investigated and its generic position fixed. Coming from a locality difficult of access, and poor in fossils, it seems proper to admit this reference to its existence.

Collected by A. Winchell at Point aux Barques, Huron County, Michigan, at the base of the Marshall group.

p. 413 SANGUINOLITES CONCENTRICA, Win., (*Cardinia concentrica*, Win., Proc. Acad. Nat. Sci. Phila., Sept., 1862, p. 413). Collected by A. Winchell at Alan's and Germain's quarries, Hillsdale, Hillsdale County, Michigan.

This species is the analogue of *Cardinia tellinaria*, Goldf. sp., (Petr. Germ. ii. 180, pl. 131, fig. 17), but is more enrolled and more distinctly furrowed. It resembles also, in external characters, *Allorisma Hannibalensis*, Shum.

In the original description of this species, "ventral," in the second line, should be changed to "vertical."

SANGUINOLITES HANNIBALENSIS, Win., (*Allorisma Hannibalensis*, Shum.) The single specimen collected by the writer at Alan's quarry, Hillsdale, Michigan, less resembles the original figure than it does the Burlington specimens referred to this species. The Hannibal type is more elongate, with broader furrows.

This species also occurs, satisfactorily identifiable, in both the conglomerates spoken of under *Edmondia*.

CARDIOMORPHA JULIA, Win. Occurs at Napoleon Cut, Jackson County, Michigan. Collected by A. Winchell.

‡ LEDA BELLISTRIATA, Stevens. This has been collected by A. W. at Alan's and Germain's quarries, Hillsdale, Michigan.

CTENODONTA, Salter.

See p. 417 CTENODONTA HUBBARDI, Win., *Nucula Hubbardi*, Win., Proc. Acad. Nat. Sci. Phila., Sept., 1862, p. 417; ? = *Nuculites sulcatina*, Conrad, Jour. Acad. Nat. Phila., viii. p. 250, pl. xv. fig. 10). Collected by A. W. at Napoleon Cut, Jackson County.

Amongst my collections from the Marshall group are numerous specimens generically closely allied to, if not identical with, *Nucula*, from which I have described *N. Hubbardi*, *sectoralis*, *stella* and *Iowensis*—the latter having been originally described by White and Whitfield from the yellow sandstones at Burlington, Iowa. To the Iowa species I have added another—*N. microdonta*. These five species all present a line of teeth continuous from one side of the beaks to the other, without the ligamental pit which belongs to the modern species of *Nucula*. This variation attracted my attention at the very first; and I observed that the hinge characters seemed to identify the species with *Tellinomya*, Hall, and *Ctenodonta*, Salter. A species from the Hamilton group, and identified again in the Chemung group, had been described by the subsequent founder of *Tellinomya*, as *Nucula bellatula*, (Rep. 10th Dist. N. Y., p. 196); and *Nucula hians* had also been recently described by him (xiii. Rep. N. Y. Regents, p. 110) from rocks of nearly the same age in Indiana, to say nothing of the description by Stevens of *N. Houghtoni*, from the Marshall group. Without being acquainted with the details of the hinge structure of these species last mentioned, I yielded to the influence of example in referring my species to *Nucula*. I did this the more readily, as Prof. Hall had expressed the conviction (x. Report N. Y. Regents, p. 184) that *Tellinomya* would prove to be a Silurian genus. It may be added to this, that *Nucula ventricosa*, Hall, (Iowa Rep. p. 716, pl. 29, fig. 4, 5) does not possess the ligamental pit of a modern *Nucula*, although it offers rather important departures from *Tellinomya*.*

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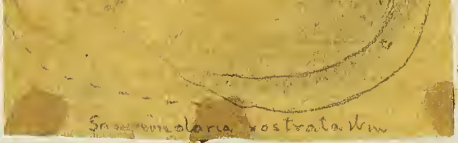
* A fossil from the Coal Measures of Lasalle, Illinois, usually identified with *N. ventricosa*, Hall, exhibits *no teeth* whatever on the anterior side of the beaks, and thus presents generic characters heretofore unobserved. This feature is shown in several separated valves mineralized by Pyrites. This character would seem to possess equal importance with the absence of the ligamentary pit, on which *Ctenodonta* has been founded.

‡ If from the Waverley horizon I should doubt its identity with L. bellistriata, Stevens.

Not same family as Sanguinolaria



From Winchells figure. I believe this and S. similis on page opposite 421, to belong to the Carbonicola or some allied genus of the Craſsatellidae

The uninterrupted series of teeth possessed by the Nuculoid shells already referred to, from the Marshall group and its supposed equivalents, seems to constitute good grounds for a generic separation. For this hinge structure three names have been suggested. *Nuculites* was assigned by Conrad to shells having a continuous series of teeth and an internal clavicular ridge like *Clidophorus*. This genus has a real existence in the Hamilton group. *Tellinomya* has been applied by Hall, and *Ctenodonta* by Salter, to shells having the generic characters of the species under consideration. As, however, objections have been urged against the import of the name *Tellinomya*, and, on the other hand, Prof. Hall insists upon the rights of priority over *Ctenodonta*, (x. Report N. Y. Regents, p. 181), it becomes a delicate matter to decide between the two. But since the genus *Tellinomya* was not founded upon characters possessing generic value, while the real generic characters, owing to the state of preservation of the specimens, entirely escaped observation; and, since the name proposed actually conveys a false idea of the relations of the genus, I feel constrained, in spite of my desire to perpetuate an American name, to pursue the same course as I do in regard to *Athyris* and other terms founded upon a misapprehension, and, in their meaning, at variance with facts.

In regard to *Ctenodonta Hubbardi*, I desire further to admit the possibility that this is the species described by Conrad under the name of *Nuculites sulcatina*. All that is stated in the description applies to this species; and the figure also agrees. Nothing, however, is said or shown respecting the hinge structure; and both the description and figure will apply nearly as well to *Sanguinolites concentrica*, Win., which occurs abundantly at the locality whence Conrad's specimens were obtained; while *Ctenodonta Hubbardi*, so far as I have observed, is unknown at that locality. The latter, nevertheless, approaches nearest to *Nuculites*; and it may be fair to presume that Conrad had a view of the hinge structure of the specimens he described. But it must be stated, finally, that not one of the hundreds of specimens that I have had in my hands, furnishes evidence of the existence of the internal septum which is essential to *Nuculites* and *Cucullela*. For the present, therefore, I feel compelled to regard *Nuculites sulcatina*, Con., as a species that has not yet fallen under my observation.

Conrad, in the paper referred to, has described *Nuculites mactroides*. If this is really a Nuculoid shell it approaches *Ctenodonta sectoralis*, Win., without being identical. If not a Nuculoid shell, as I suspect, it approximates *Edmondia æquimarginalis*, Win., but at the same time, I could scarcely identify it. For the present, therefore, I leave it as I have left the species just referred to.

Ctenodonta stella, Win. (=*Nucula stella*, Win.,) also occurs at Napoleon Cut, Jackson county, Michigan.

SANGUINOLARIA, Lamarck.

Sanguinolaria rostrata, n. sp. Shell rather large, transverse, cuneate-ovate in outline, of medium convexity. Beaks two-fifths the shell length, from the anterior end, quite prominent, and rather strongly incurved. Greatest convexity above the middle, continuing along the postero-dorsal slope. Hinge line somewhat more than one-third the length of the shell, slightly angulated between the beaks; buccal slope slightly curved, the anal nearly straight; extremities obtusely rounded; ventral margin nearly straight in the middle region, curved rapidly beyond. Longest dimension equidistant between the beaks and venter. Pallial impression deep, without sinus (?); anterior muscular pit deep on the rostral side, roundish-oval, striate radiately and concentrically; equidistant between the beaks and extremity; posterior muscular pit more elongate; a feeble ridge extends from the beak along the inner border of each muscular pit—more perceptibly the posterior. In the right valve a strong triangular cardinal tooth stands just anterior to the point of the beak, and is bounded posteriorly by a deep triangular pit, and anteriorly by a shallower and narrower one. Nothing further is clearly known in reference to the hinge. The shell seems to be thick and externally smooth.

Length, 1·72 (100); height, 1·13 (66); convexity of one valve, ·34 (20); distance from beak to anterior extremity, ·55 (32); to posterior extremity, 1·21 (70).

Collected at Battle Creek, Michigan, by A. W.

Resembles *S. similis*, Win., but differs in more prominent beak, greater convexity and straight ventral margin.

Sanguinolaria similis, Win., occurs at Napoleon Cut, Jackson county, Michigan.

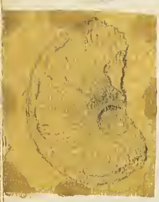
CONULARIA, Miller.

Conularia Newberryi, n. sp. Shell very small, in the form of a quadrangular pyramid, (the apex of which has been broken off in the specimen described.) The pyramid is inclined over one of the angles. Angles of the pyramid slightly rounded, and marked by a shallow groove running longitudinally. Each side is marked by sharp, raised, transverse lines, which, instead of running directly across, are angulated in the middle, so that at this point they are nearer the base of the shell by a distance equal to once and a half the distance between two lines. The distance between the lines increases from above downwards, and is everywhere equal to about one-ninth the width of the side. These transverse lines have the appearance of the projecting edges of septa, and are continuous from the middle of one of the shorter sides of the pyramid around to the same point, though the ends do not join but alternate in position. The sides of the pyramid are inclined at an angle of 30°, and, if they met at a point in the perfect specimen, it must have been about half an inch in length, with a width at base of about ·17 inch.

Collected by A. Winchell, at Cuyahoga Falls, Ohio, in the water limestone below the conglomerate.

Named in honor of Prof. J. S. Newberry, M. D., equally distinguished in the service of science and of his country.

BELLEROPHON, Montfort.



B. Whittleseyi Win. from Winchell's drawing.

Bellerophon Whittleseyi, n. sp. ("Goniatite," figs. 1 and 2, Whittlesey, Proc. Amer. Assoc. Cincin., p. 219.) Shell rather large, globoid, rapidly enlarging, umbilicus moderately large, exposing one anterior whorl. Transverse section triangularly and broadly lunate, the dorsum being slightly elevated, and the dorso-lateral slopes slightly flattened; greatest diameter of section near the umbilicus. Keel rather distinct but with an indistinct band. Surface marked by raised, rather distant striæ, which emerge from the umbilicus with a slight backward inclination, and, curving forwards, pursue a course directly across the lateral surfaces for two-thirds the distance from the lateral to the dorsal angle, where they undergo a sudden deflection backwards, making with themselves very nearly a right angle, and forming on the dorsum, by the meeting of opposite branches, a retral angle of 45°. Sinus not seen, but probably triangular and broad.

Greatest diameter of whorl, ·87; dorso-ventral diameter of aperture, ·57; number of striæ in one-tenth of an inch, near the aperture at the point where they turn backwards, 3 to 3½.

This species resembles *B. rugosiusculus*, Win., in general features, but lacks the longitudinal decussating striæ. It may be distinguished from all related species by the peculiar geniculation of the striæ in the dorso-lateral region.

One mile east of Orange Center, Cuyahoga county, Ohio, 20 or 30 feet below the grindstone grit. Whittlesey's collection.

Bellerophon nautiloides, Win., (Proc. Acad. Nat. Sci. Phil. Sept. 1862, p. 427.) Collected by A. W., at Alan's quarry, Hillsdale, Michigan.

Conrad has described *B. stamineus*, from Moscow, Hillsdale county, Michigan, at which place I have observed both *B. nautiloides* and *B. galericulatus*, Win., and it is probable that he had one of these species in view in his description. The *ten words* employed in the description, however, will apply equally well to half a dozen species of *Bellerophon;* and it is hence utterly impossible to avail myself of the results of his studies.*

Bellerophon cyrtolites, Hall. This widely distributed species has been found at Alan's quarry, Hillsdale, Michigan.

Pugiunculus? aculeatus, Hall. This Rockford species has been collected by A. W., at Alan's and Germain's quarries, Hillsdale, Michigan.

Dentalium? Barquense, Win., (Proc. Acad. Nat. Sci. Phil., Sept. 1862, p. 425.) Additional specimens from the same locality, show that the short tubes supposed to belong to the shell structure, are not always normal to the surface; and that when the internal cylinder is removed, so as to afford a view of the inner surface of the prismatic coating, the oblong sections of the prisms as they were applied to the cylinder, look somewhat like the polyp cells shown in longitudinal sections of some branching corals; and there is seen also something like the same divergent disposition of the tubes. Moreover, the structure is extremely like that referred to in the last paragraph of my paper in the Proceedings for Sept. 1862, p. 430. This latter structure is foliaceous, but occurs at the same locality. Can these rigid stems, then, be corals with very large hollow axes?

METOPTOMA, Phillips.

Metoptoma undata, n. sp. Shell of medium size, nearly erect, apex nearly central, aperture transversely slightly elliptic; body of shell most inflated in the middle, somewhat acuminate toward the apex, and contracted at the aperture. Cast nearly smooth over the body of the shell, longitudinally undulate near and at the aperture, with a few wavy concentric lines of increment.

Height of shell, 1·15 (100); longest diameter of aperture, 1·06 (92).

From Bed "No. 5," Burlington, Iowa. "White Collection" of the University of Michigan.

The inferior side of the only specimen seen is defective; yet there are indications that it was flattened, as in the typical species of Prof. Phillips.

Platyceras paralium, White and Whitfield. Identified in the Lithographic limestone of Clarksville, Missouri. "White Collection."

A variety more robust than the typical form, and wanting in the longitudinal folds which characterize the latter, occurs in the base of the Burlington limestone at Burlington.

Platyceras vomerium, Winchell. From Sheldon's saw-mill, Big Brook, Orange, Cuyahoga county, Ohio, below grindstone grit. Whittlesey's collection.

The Ohio specimens have a dorsum not quite so acute as the Iowa types, and an aperture a little less expanded.

PLEUROTOMARIA, Defrance.

Pleurotomaria quinquesulcata, n. sp. Shell of medium size, depressed—conical, consisting of three or four rapidly enlarging whorls. Outer whorl nearly as wide as all the others, having a nearly circular section, and presenting on its exterior about five broad longitudinal furrows, covering the space from the suture above to the base below; shell otherwise apparently smooth.

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* In the 4th line of my description of *B. galericulatus*, (loc. cit. p. 426,) for "ventrally," read "retrally."

Diameter of last whorl, 1·07 (100); height of spire, about ·72 (67).

From the oölitic bed "No. 6," Burlington, Iowa. "White Collection" of the University of Michigan.

This species is imperfectly known, though clearly distinct from all other species of this age, and hence deserving of notice. It is probable that the base is regularly rounded into a broad and deep umbilicus, and that the aperture is nearly circular. It calls to mind *Euomphalus carinatus*, Sow., from the "Aymesbury limestone," but the sulcations are only half as numerous.

A similar species exists in Whittlesey's collection, from "Sheldon's saw-mill, Big Brook, Orange, Cuyahoga county, Ohio, below grindstone grit."

Pleurotomaria vadosa, Hall, (xiii. Rep. N. Y. Regents, p. 108.) To Prof. Hall's description of this species, founded upon casts, may be added the following observations on the shell: The periphery of the body whorl is flattened into a sharp carina, just above which is another, heavier one, but not quite so projecting; a concave belt separates these from another pair of ridges which lie near the suture, and are interrupted by numerous regular transverse rugulations rising into minute nodes, on the ridges.

Collected at Rockford, Indiana, by A. Winchell.

Straparollus macromphalus, Win. Specimens having twice the diameter of the types of the species, showing the tube septate a little more than one whorl back from the aperture. One specimen preserving the shell, shows that it was marked only by incremental lines.

From bed "No. 1," and the oölitic layer, "No. 6." "White Collection" of the University of Michigan.

Straparollus ammon, White. This Burlington species occurs in the so-called millstone grit of Western New York, and was figured as *Euomphalus depressus*, Hall, (Geol. Rep. ivth Dist. New York, p. 291.)

Orthoceras Indianense, Hall. Collected by A. W., at Alan's and Germain's quarries, Hillsdale, and Napoleon Cut, Jackson county, Michigan.

Nautilus (Trematodiscus) discoidalis? Win. A small fragment from Rockford, Indiana, affords strong presumption that this species existed at that locality.

CYRTOCERAS, Goldfuss.

Cyrtoceras Rockfordense, n. sp. Shell rather large, rapidly expanding, especially toward the aperture, apparently forming, in adult age, nearly a complete whorl. In some specimens the transverse section is subcircular or laterally compressed, in others decidedly elliptic, being flattened dorso-ventrally. The curvature is rapid for a shell of so large size, which renders it necessary that the chambers should be about four times as deep on the outer as on the inner side of the whorl. Septa deeply and regularly concave; siphon small, situated close to the dorsal side. No surface markings are preserved on casts.

Transverse diameter of the last chamber, in a specimen wholly septate, 1·86 (100); dorso-ventral diameter, 1·35 (72); depth of chamber on the dorsal side, ·59 (32); on the ventral side, ·13 (7); diameter of siphon, ·10 (5). In another specimen the transverse diameter of a section is 1·60; the dorso-ventral diameter, ·170.

Collected by A. Winchell, at Rockford, Indiana.

It is impossible to affirm that this species did not describe one or more detached volutions. In case such was its character, it must have borne a close resemblance to *Nautilus cyclostomus* (Phillips) de Kon., (Anim. Foss. 553, pl. xxv. 1, a, b; xlix. 1, a, b.)

Winchell writes that Cyrtoceras Rockfordense
[illegible] is synonymous with [illegible]

Goniatites Allei, Win. The most perfect specimens seen were collected by A. W., at Germain's quarry, Hillsdale, Michigan. Apertural constrictions occur at regular intervals.

Goniatites Marshallensis, Win. Collected by A. W., at Napoleon Cut, Jackson county, Michigan.

Occurs also at Weymouth, Medina county, Ohio, 80 feet below the conglomerate. Whittlesey's collection.

PHILLIPSIA, Portlock.

Phillipsia Doris, Win. (=*Proetus Doris*, Hall, xiiith Rep. N. Y. Regents, p. 112.) This species was established by Hall on some pygidia occurring in the Goniatite limestone at Rockford, Indiana. I am in possession of several pygidia from this locality which agree with his description, though in the absence of measurements, it may be that his specimens are much larger. Associated with these are numerous fragments of bucklers, which prove that the trilobite is a *Phillipsia.* The head is furnished with a border sloping downwards, and separated from the cheeks by a deep but narrow groove; the middle of the border is marked by a groove which reaches from a point opposite one eye, to the corresponding point on the other side of the head; in some specimens the latter groove reaches backward to the posterior borders of the buckler. The cheeks are raised abruptly above the border, and terminated by spinous points which are ornamented with raised longitudinal striæ, and extend backwards a distance equal to one-third the whole length of the cephalic shield. The principal lobe of the glabella is in the form of a prolate semi-ellipsoid, is almost destitute of furrows, and is supported on each side by a large complementary lobe. The surface is obscurely granulose. The pygidium is in the form of a semi-ellipse, with the longer diameter transverse; it is convex, with a gibbous axis, obtuse posteriorly, and articulated to the extremity. The lateral lobes are a little narrower than the axis, and their terminal points join the extremity of the axis. The pygidium is bordered by a plain belt curved downwards around its margin, and barely marked by a continuation of the articulations—except the two which bound it anteriorly. Number of segments in the axis, 11; in the side lobe, 7; surface the same as in the buckler.

Width of pygidium, ·35; length, ·21; width of axis at anterior end, ·12; width of border, ·04. Length of buckler of another specimen, ·31.

Proetus Missouriensis, Shumard, (Missouri Report, p. 196, pl. B, fig. 13, a, b,) would seem also to be a *Phillipsia*, as well as its Ohio representative, *Proetus auriculatus*, Hall, (xv. Rep. N. Y. Regents, p. 107.) Pictet says of *Proetus*, "La glabelle est lobée par des sillons," and of *Phillipsia*, "La glabelle est composée d'un grande lobe median simple, et de deux petits lobes latero-postérieurs." Furthermore, *Proetus Swallovi*, Shumard, (loc. cit.) does not present the posterior termination of the great suture required by the genus to which it stands referred.

Phillipsia Rockfordensis, n. sp. Cephalic shield surrounded by a narrow, convex border, which is bounded internally by a narrow but deep groove, and terminates posteriorly in conically tapering genal points. The principal lobe of the glabella is relatively very large, convex, highest in the middle, widened anteriorly, circularly rounded in front, and gently curved on the sides; no glabellar furrows are present. The complementary lobes are large, oval, and project laterally farther than the main lobe. The surface of the test of the glabella is finely, but sharply granulated; that of the border is finely striated. Size about the same as that of *P. Doris.*

Collected by A. W., at Rockford, Indiana.

Cythere crassimarginata, Win. Collected by A. W., at Alan's and Germain's quarries, Hillsdale, Michigan.

University of Michigan, *Ann Arbor*, 13*th May*, 1865.

5 Recd Sept. 18th 1866
Ford. fr. Smithsonian to Springfield

Ext. From Report on Grand Traverse Region
p. 83.
1866

APPENDIX

TO A REPORT ON THE GRAND TRAVERSE REGION.

By A. WINCHELL.

Paleontological investigations made since the printing of the body of this Report, enable me to present a more satisfactory account of the Hamilton group of Little Traverse bay than has hitherto been done. This region possesses considerable geological interest, in consequence of being removed at least 250 miles in a straight line from the nearest Hamilton rocks, (at Widder, C. W.,) which have heretofore received the attention of paleontologists.

To co-ordinate the various outcrops along the shore of the bay and lake, as far as the black shale beds, is a problem of no little difficulty, since the shore-line runs nearly in the strike of the strata, and the latter present numerous irregular undulations, and undergo, moreover, considerable lithological changes in short distances. By fixing upon certain obvious paleontological horizons, however, and parallelizing strata which are obviously synchronous, all the various localities and strata fall by degrees into their proper places.

In default of a diagram, I have arranged the following table to exhibit to the eye the stratigraphical relations of the several localities. The term "Tropidoleptus Beds" is changed to "Bryozoa Beds," since the supposed *Tropidoleptus* proves to be a *Strophodonta.* A "Pleurotomaria Bed," well marked, is also recognized at the bottom of the series. The letters correspond with those in the sections given in the body of the Report. The full-face capitals indicate the strata most readily identifiable.

STRATIGRAPHICAL RELATIONS OF THE LOCALITIES.

	855	856	857	858	861	862	863	865	880	881	884
Chert Beds................	...	...	...	...	...	...	...	...	...	...	**E** **D** C B A
Buff Magnesian Beds......	...	...	...	...	...	...	...	**E** **D** **C**	...	...	...
Acervularia Beds...........	...	...	E D G	**B** A	D C **B** A	C **B** A	**B** A	B **A**	D **C**	**A**	C
Bryozoa Beds..............	...	...	B **A**	...	...	...	...	...	**B** A	...	...
Stromatopora Beds.........	...	D **C**	...	...	...	...	...	...	...	...	...
Pleurotomaria Bed..........	B **C** B A	**B** **A**	...	...	...	...	...	...	...	...	...

The table which follows embraces a list of all the fossils thus far collected, including the collections of my recent survey and those heretofore made by State authority. The five succeeding columns of the table show the vertical distribution of the species through the beds.

DISTRIBUTION OF THE SPECIES.

CATALOGUE.	*Pleurotomaria Bed.*	*Stromatopora Beds.*	*Bryozoa Beds.*	*Acervularia Beds.*	*Magnesian Beds.*
Fistulipora labiosa *Win*............				*	
“ Saffordi *Win*...........			*	*	
Callopora punctillata *Win*..........			*	*	
Favosites Alpenensis *Win*..........			*	*	*
“ nitella *Win*..............			*	*	
“ dumosa *Win*.............	*	*			
Lunatipora Michiganensis *Win*.....	*				
Alveolites strigillata *Win*...........				*	*
“ megastoma *Win*.........				*	
“ n. sp ?.............		*			
Chætetes Hamiltonensis *Win*........				*	
“ microscopica *Win*.........			*	?	
Syringopora fenestrata *Win*.........				*	
“ alectiformis *Win*.......				*	
“ crassata *Win*...........					*
Zaphrentis Traversenis *Win*........	*	*	*	*	
“ cystica *Win*............				*	
Cyathophyllum simplex ? *Hall*.....				*	
“ panicum *Win*......		*			
“ ? partitum *Win*....			*		
“ sp ?					*
Heliophyllum Halli *E. & H.*........	*				
“ tenuiseptatnm *Bill*...			?	*	
Acervularia Davidsoni *E. & H.*.....			*	*	
Phillipsastræa Verneuili *E. & H.*...			*		
Cystiphyllum Americanum *E. & H.*				*	
Stromatopora monticulifera *Win*....		*		*	
“ pustulifera *Win*......		*			
“ nux *Win*.............		*			
“ cæspitosa *Win*........		*			
Aulopora serpuloides *Win*..........				*	
“ aperta *Win*.............			*	*	
“ conferta *Win*.............				*	
“ cyclopora *Win*...........				*	
Tentaculites subtilis *Win*...........			*		
Fenestella eximia *Win*.............				*	
“ filitexta *Win*...........			*		
Stictopora sulcata *Win*.............			*		
Crania radicans *Win*...............				*	
“ crenistria *Hall*..............				*	
“ (Pseudocrania) anomala *Win*				*	
Chonetes Emmetensis *Win*.........			*		
Strophodonta inæquistriata *Con*....				*	
“ subdemissa *Hall*......			*	*	
“ erratica *Win*. (3 Vars.)	*	*	*	*	
“ imitata *Win*.........				*	
“ ampla (*Hall*) *Bill*.....			*		
“ cincta *Win*..........			*		

DISTRIBUTION OF THE SPECIES.—*Continued.*

CATALOGUE.	*Pleurotomaria Bed.*	*Stromatopora Beds.*	*Bryozoa Beds.*	*Acervularia Beds.*	*Magnesian Beds.*
Strophodonta nacrea *Hall*			*		
Cyrtia Hamiltonensis *Hall*	*	*	*	*	
Spirifera Clintoni *Hall*			*	*	
" subattenata *Hall*				*	
" bidorsalis *Win.*				*	
" mucronata *Con.*			*		
" pennata (*Owen*) *Hall*			*		
" consors *Win.*	*	*			
" filitexta *Win.*		*			
Martinia athyroides *Win.*	*				
Spirigera concentrica *Bronn*		*	*	*	*
" eborea *Win.*			*		
Merista lens *Win.*	*	*			
Trematospira ? liniuscula *Win.*		*			
Atrypa reticularis *Dal.*	*	*	*	*	
Pentamerus occidentalis *Hall*		*		*	
" intralineatus *Win.*			*		
Leiorhynchus sesquiplicatus *Win.*			*		
Terebratula Linklæni *Hall*				*	
" Traversensis *Win.*	*	*	*	*	
Pterinea decussata *Hall sp.*			*		
Aviculopecten intercostalis *Win.*			*		
Sanguinolites (Grammysia ?) sulcifer *Win.*				*	
Lucina ? Hamiltonensis *Win.*			*		
Conocardium Emmetense *Win.*			*	?	
" bifarium *Win.*		*			
Edmondia ? ledoides *Win.*	*				*
" mactroides *Win.*	*				*
Nuculites oblonga ? *Hall*			*		
Pleurotomaria mucro *Win.*					*
" cavumbilicata *Win.*	*				
" Emmetensis *Win.*	*				
" parvispira *Win.*	*				
Orthoceras exile ? *Hall*	*		*		
" pustulosum *Win.*			*		
" sp ?	*				
Gomphoceras omicron *Win.*				*	
Spirorbis omphalodes *Goldf.*			*	*	
" ammon *Win.*				*	
" obesa *Win.*				*	
Phacops rana *Green*	*	*	*	*	
Dalmania Boothi *Hall*				*	
Fish Bones	*				
Cycliferous Ganoid Scale			*		

The group contains also an undetermined *Taeniopteris* and a *Lichenalia.*

The following digest of the foregoing table sets forth the paleontological grounds of the distinction into different beds.

	Total Species.	*Restricted.*	*In two Beds.*	*In three Beds.*	*In more than three.*
Magnesian Beds....................	8	3	3	1	1
Acervularia Beds..................	46	24	14	2	6
Bryozoa Beds......................	41	21	12	1	7
Stromatopora Beds................	21	9	5	1	6
Pleurotomaria Bed................	20	8	6	1	5

The Acervularia and Bryozoa Beds, while each holds more than 50 per cent. of species not ranging beyond it, contain 19 species, or 28 per cent. of the whole, in common. Lithologically they may be described as a series of dark, bituminous limestones and shales; and in the general facies of the formation, they present themselves structurally as one mass. Below this mass is another of strikingly different aspect, composed of pale buff, massive limestones, with little shaly or bituminous matter, in which I have distinguished the Stromatopora and Pleurotomaria Beds; which, while each holds about 38 per cent. of peculiar species, contain at the same time 9 species, or about 20 per cent. of the whole, in common. Above the Acervularia Beds we find another physical change in the Magnesian Beds. These are dark-buff, coarse, rough, vesicular, with few fossils. Of these, 3 or 38 per cent. are peculiar; 2 are species which have too wide a vertical range for use in stratigraphical determinations, and 2 are singularly identified with species in the bottom of the formation. The Chert Beds present another set of physical characters; though I suspect the amount of Chert is very variable.

I would suggest then, as the most obvious and tenable method of grouping the strata, the following:

IV. Chert Beds.
III. Buff, vesicular Magnesian Limemstones.
II. Bituminous Shales and Limestones. { Acervularia Beds.
Bryozoa Beds.
I. Pale-buff, massive Limestones. { Stromatopora Beds.
Pleurotomaria Beds.

This grouping of the strata will hold good, I think, throughout the State, and perhaps in other regions. Judging from the fossils, the Acervularia Beds outcrop at Iowa City, and the Bryozoa Beds at New Buffalo, in Iowa. On the eastern side of the peninsula of Michigan, the rocks with *Stromatopora* are seen to be succeeded downwards by the recognized Corniferous limestone. Indeed, the two are here, as in lake Erie, but one mass, physically.

DIAGNOSES OF NEW SPECIES.

Fistulipora labiosa.—Incrusting in thin layers; the delicate cell-mouths surrounded by distinctly elevated and tumid lips; intercellular surface smooth; intercellular tissue consisting of minute polyhedral vesicles—a radiating series often surrounding the minutely septate cells. Intercellular distances .33 mm. (.013)[*]; diameter of cell-mouths .381 mm. (.015); distance of septa .102 mm. (.004).

Fistulipora Saffordi.—Incrusting in thin layers; cell-mouths scarcely elevated, without thick lips; intercellular surface generally exposing the minutely vesicular tissue; vesicules often radially disposed around the cells. Intercellular distances .254 mm. (.01); diameter of cell-mouths from .355 mm. (.014) to .508 mm. (.020).

Callopora punctillata.—Delicate incrustations; cells approximate, but cylindrical or compressed-cylindrical—occasionally crowded and sub-prismatic; intercellular structure minutely vesicular, or, in places, wanting. Intercellular distances .127 mm. (.005) or less; diameter of cell-mouths .152 mm. (.006).

Favosites Alpenensis.—Related to *Calamopora polymorpha* Goldf. Always massive; mural pores arranged in one (sometimes two) irregularly or scarcely lineal series on each side—their margins indented instead of raised. Walls distinctly double, quite smooth; septa extremely thin. Cells smaller and pores more numerous than in *F. Billingsi* Rominger. Distance of pores 2.286 mm. (.09); of septa 1.270 mm. (.05).

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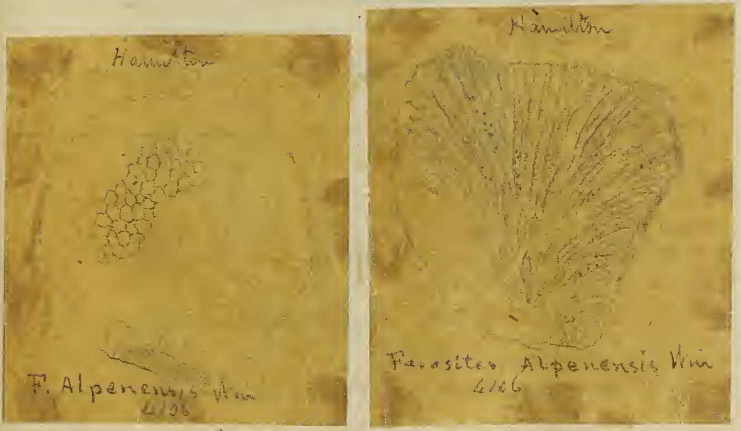
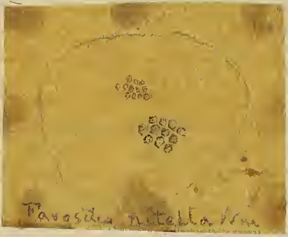
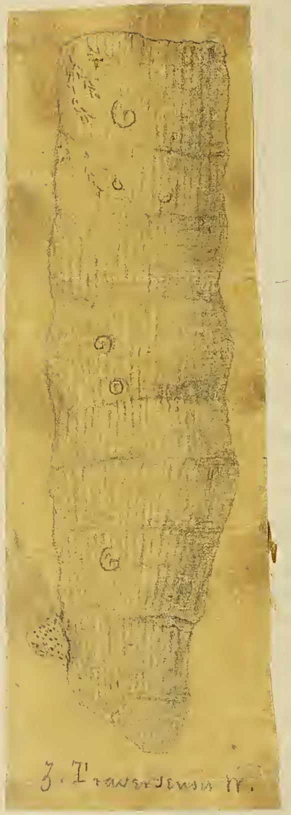
[*] Measurements in millimetres. Numbers in parenthesis are equivalents in inches.

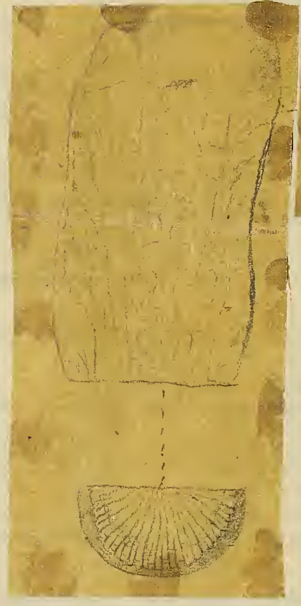


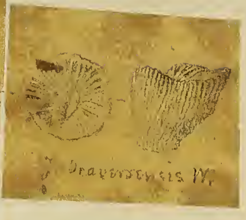
From Prof. Winchell's drawings



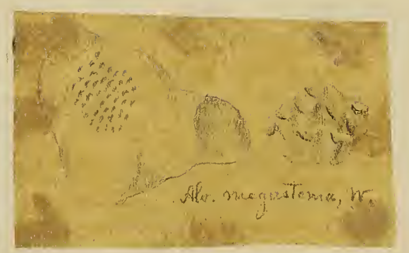
From Prof.
W's drawing


Z. Traversensis W.




Z. Traversensis W.

Zap. Traversensis W.
All from Winchells drawings
See page 90 –


Alv. megastoma, W.

From Prof. W's drawings.

FAVOSITES NITELLA.—Related to *C. spongites*, var. *ramosa* Goldf. In small masses varying from globoid to elongate or scarcely branching. Cells sub-circular, sub-equal, with a few minute interstitial ones. Septa distinct, irregular, complete or incomplete; pores scattered, indented around the orifices. Distance of pores .76 mm. (.03); diameter of largest cells .76 mm. Occurs also at Iowa City.

FAVOSITES DUMOSA.—Resembles *F. Alpenensis* in size and form of cells and cell-mouths, and in size and arrangement of pores, but differs in much more crowded and thicker septa, and in growing in stout, thickly-clustered branches. Distance of septa .51 mm. (.02).

LUNATIPORA (New Genus).—Massive, or with branches consolidated; cells elongate, radiately ascending and curving outwards from an imaginary flexuous axis, compressed, their transverse section bounded by two or three segments of circles, often sub-crescentic; walls apparently double, but not separable (?); destitute of communicating pores as far as known; interior with transverse diaphragms. Cell-mouths not seen.

Differs from *Favosites* and *Chætetes* in the form of the cells, and from the former in the probable absence of pores; from *Alveolites* and *Cladopora* in the great length of the cell-tubes, and from the latter in the presence of distinct diaphragms, and a more massive form.

LUNATIPORA MICHIGANENSIS.—Cells small, much flattened; diaphragms rather remote, complete or incomplete, often oblique. Longer diameter of larger cells 1.55 mm. (.06) to 2.03 mm. (.08); shorter diameter .51 mm. (.02).

ALVEOLITES STRIGILLATA.—Somewhat ramose; cell-mouths crowded; transverse section at aperture double-convex; outer lip slightly elevated in the middle—often with a narrow rim either inflected or reflected; inner side of aperture marked by 10–15 delicate striæ, which diverge and extend over the outer lip of the contiguous cells above. Transverse diameter of cell-mouths 1.27 mm. (.05); distances apart longitudinally 1.02 mm. (.04).

ALVEOLITES MEGASTOMA.—Thin incrustations, with large, crowded, oblique cell-mouths which have the form of a segment of a circle in transverse section; outer lip, when perfect, lying in a plane normal to the general surface, its exterior marked by minute distinct transverse lines of growth; radial striæ very obscure. Transverse diameter of cell-mouths .28 mm. (.11); distances apart longitudinally, the same.

CHÆTETES HAMILTONENSIS.—Incrusting, or in solid tubercular masses or stems, with crowded, prismatic tubes .25 mm. (.01) in diameter, diverging in all directions at right angles with the main axis; cell-walls simple; septa complete .25 mm.

(.01) to .51 mm. (.02) apart. A similar Canadian species has larger tubes and spinuliferous cell-mouths.

CHÆTETES MICROSCOPICA.——Generally small, cylindrical, solid branches, formed of radiately ascending and curving, crowded, polygonal non-septate tubes. Diameter of cell-mouths .28 mm. (.011).

SYRINGOPORA FENESTRATA.—Habit and characters similar to the following, but smaller. The young somewhat resemble *Aulopora tubœformis* Hall (not Goldf.) Diameter of tubes 2.29 mm. (.11). Occurs also in the Hamilton of C. W.

SYRINGOPORA ALECTIFORMIS.— Tubes large, loosely and confusedly aggregated, prostrate or declined, adhering to other corals, in the young state auloporiform; exterior smooth or faintly wrinkled; interior feebly striate. Diameter of tubes 4.06 mm. (.16) to 5.84 mm. (.23).

SYRINGOPORA CRASSATA.—Tubes of medium or moderate size, very geniculate and confused, externally much wrinkled transversely; irregularly constricted, often compressed; tube-walls unusually thick—the central cavity often nearly obliterated. Diameter of tubes 1.52 mm. (.06) to 2.03 mm. (.08).

See last interleafed sheet.

ZAPHRENTIS TRAVERSENSIS.—Fossette rudimentary. Differs from *Cyathophyllum simplex* Hall in its more abundant epitheca, less contorted lamellæ, its finely vesicular outer zone, and its more elongated and erect form. Often attached obliquely.

ZAPHRENTIS CYSTICA.—Outer zone of finely vesicular tissue reaching nearly half way to the center; central septa very thin and irregular; lamellæ about 60, of which half terminate with the vesicular zone.

CYATHOPHYLLUM PANICUM.—Having the form and size (or somewhat smaller) of detached stems of *Diphyphyllum Archiaci* Billings, but without the double wall. Resembles *C. cæspitosum* (Goldf.) E. & H., but is more delicate and more straggling.

CYATHOPHYLLUM ? PARTITUM.—Tubes small, branching; walls thick, without radial lamellæ or visible striæ; internal cavity divided by irregularly disposed vertical partitions, which, in transverse sections, describe the chord (instead of radius) of a circle; space inclosed between the lamellæ and walls transversely and minutely septate. The same structure extends into the branches. Epitheca slightly wrinkled. Diameter of tubes 7.62 mm. (.3). Scarcely conforms to any established genus.

STROMATOPORA PUSTULIFERA.—In very large, spheroidal, ovoid or elongate masses, composed of arching, transverse layers, formed of laminæ of coralline substance separated by a network of minute passages which, at intervals, coalesce and turn upwards through the layer, radiating and ramifying again on its upper side. The places where the layers are thus traversed are raised on the upper side into little eminences. The distinction of layers is produced by variations in the density of the coralline substance. Masses of coral several feet in diameter; distance of pustules 4.06 mm. (.16); mean thickness of laminæ .20 mm. (.008). Occurs also at Iowa City.

Stromatopora monticulifera.—In very large spheroidal masses constituted like those of *S. pustulifera*, but differing therefrom in the much larger and more remote eminences on the upper surfaces of the concentric beds, and in the larger and more distinctly radiate character of the passages which diverge from the apices of the monticules. These passages, on the exposed surface, are little flexuous, somewhat branching channels which diminish in size and disappear within 5 mm. (.2). Distance of monticules .76 mm. (.3) to 10.2 mm. (.4). Attains a diameter of at least 3.5 metres (12 ft.)

Stromatopora nux.—In small, spheroidal, sometimes contiguous and coalesced masses, formed, unlike the foregoing species, by accretions on all sides. External surfaces of layers not pustulose. Masses occur from 25 mm. to 125 mm. in greater diameter. A species apparently the same occurs on Kelly's Island, lake Erie.

Stromatopora cæspitosa.—In general form resembling a large, cæspitosely branching, cyathophylloid coral; stems externally in contact or more than 25 mm. distant. A longitudinal section shows the characteristic layers arching across the stem and resembling *S. pustulifera* in miniature; a transverse section exhibits radiating lamellæ as in Cyathophyllidæ, but there is no outer wall, and the interior is completely filled with concentric circles of coralline substance, except a small perforation in the center. Mural system entirely wanting, as in other Stromatoporæ; exterior of stem longitudinally triate. Diameter of stems 4.5 mm. (.18) to 7.6 mm. (.30). Occurs in masses two or three feet in diameter.

This remarkable species exhibits a transition from *Stromatopora* to *Cyathophyllum* and might well form the type of a new genus.

Aulopora serpuloides.—Tubes minute, long, cylindrical, sinuous; di-or trichotomously stoloniferous, often superimposed; cell-mouths circular or compressed, generally opening upwards, not salient. Diameter of tubes .25 mm. (.01); length often 1.78 mm. (.07).

See next
interleaved
leaf

Aulopora aperta.—Tubes short, often extended in double or triple linear series; cell-mouths not elevated, generally not limited on the lower or posterior side, leaving the whole length of the tube open. Diameter of tubes 1.27 mm. (.05).

Aulopora conferta.—Tubes small, compressed, crowded, forming an incrustation; cell-mouths slightly elevated, circular, erect, sub-equally distributed, presenting a remote resemblance to a *Fistulipora*. Mean distances of cell-mouths 1.78 mm.

(.07); diameter of cell-mouths .64 mm. (.015.) Resembles *A. conglomerata* Goldf., but more consolidated.

Aulopora cyclopora.—Tubes rather long, arranged in single linear series which branch without anastomosing; cell-mouths oblique, not elevated. Length of tubes 2.29 mm. (.09) to 3.56 mm. (.14); diameter of cell-mouths 1 mm. (.04).

Tentaculites subtilis.—Minute, extremely slender, very gradually tapering; rings regular, rounded. In a terminal fragment 3.81 mm. (.15) long, the whole number of rings is 40; mean distance apart on apical third .064 mm. (.0025). Longest specimen 12.7 mm.

Fenestella eximia.—Rays angulated along the middle, bearing two rows of pores with salient margins, opening obliquely; 23 pores in the distance of ten fenestrules. Length of fenestrules .51 mm. (.02); breadth .37 mm. (.015.) This species and one similar to the preceding occur at New Buffalo, Iowa.

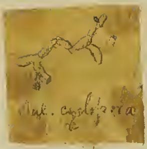
Fenestella filitexta.—Rays extremely delicate, obtusely carinated; fenestrules comparatively large and cells remote. Non-celluliferous side minutely striate. Length of fenestrules 2.03 mm. (.08); breadth .76 mm. (.03); diameter of ray .25 mm. (.01); distance of cells .18 mm. (.007); longer diameter of cells .08 mm. (.003).

Stictopora sulcata.—Small, compressed, solid, ancipital, dichotomous stems, celluliferous on both sides; cells oval, with salient lips, arranged in 6–9 longitudinal series separated by prominent rigid striæ (in one variety little developed). Greater diameter of stem 2.29 mm. (.09); less diameter .89 mm. (.035); distance between cells .2 mm. (.009); greater diameter of cells .15 mm. (.006); less diameter .1 mm. (.004.) Seven cells in 2.5 mm. (1).

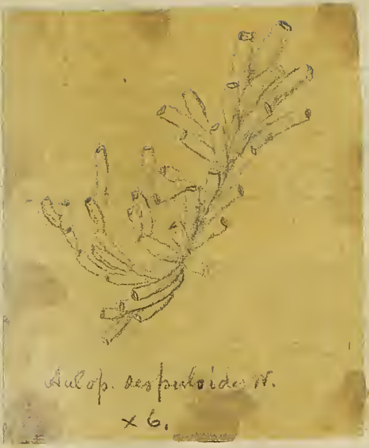
Crania radicans.—Attached valve very irregular, with distinct cardinal truncation, always presenting the appearance of area, triangular fissure and cardinal processes; central portion of valve often absorbed or wanting, leaving only the upturned border. Exterior furnished with radiciform, flexuous often bifurcate, hollow spines or appendages, sometimes as long as the shell. Diameter about 3.8 mm. (.15).

Crania (Pseudocrania) anomala.—Shell free or attached, irregular, thick; hinge line nearly equal to greatest width. Ventral valve with three or four pairs of muscular impressions, a broad, striated area, arched false deltidium nearly filling the very broad triangular fissure and fusing with cardinal processes to form a spoon-shaped orthidoid appendage. Exterior with many fine radial striæ. Transverse diameter 28 mm. (1.1); length 20 mm. (.8).

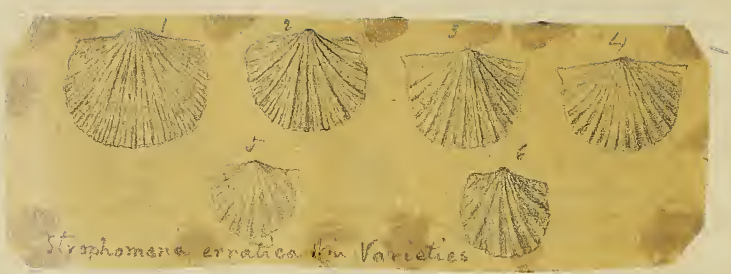
Chonetes Emmetensis.—Small, semicircular; hinge-line equal to greatest width, or slightly greater or less, armed with two short spines near each extremity, which turn out at right



From Prof W.'s fig.

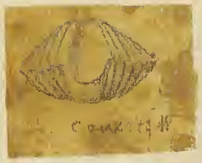


From Prof. W.'s drawing
See p. 91.

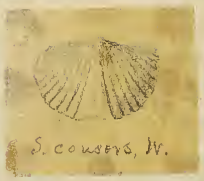


Strophomena erratica Win. Varieties

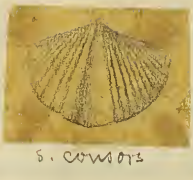
From Prof. Winchells figures. It seems to me that 1 and 2 at least, are very like the young of S. demissa, which always has the striae coarser and fewer in number on the umbo.



consors? W.

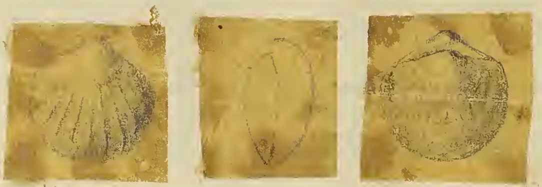


S. consors, W.



S. consors

From Winchells drawings.



See p. 94

Merista lens, W. From W's figures

angles to axis of shell, and a minute tubercle near the beak. Dorsal valve very concave. Area wide, formed equally from both valves, turned over into the plane of the shell, slightly hollowed. Triangular foramen occupied by dental process. Ribs 10 or 11 around the margin, stout, convex, simple or with two or three bifurcated ones. Concentric striæ sometimes conspicuous.

Resembles *C. gibbosa* Hall and *C. Koninckana* N. & P. in the direction of its spines, but differs from these and related species in the small number of its ribs.

STROPHODONTA ERRATICA.—Resembles *S. arcuata* Hall in hinge structure, but central cardinal process of ventral valve is narrower, and dental lamellæ denticulated. Divaricator scars drawn to a point on median line; hinge-line abruptly acuminate. Ribs few and large on the umbo, increasing by implantation, and diminishing in size toward the margin. In variety *solidicosta*, about 9 large nearly undivided ribs; in variety *fissicosta*, ribs fimbriated till they number 50 to 80 around the margin. The last variety, except in the ears, resembles *S. subdemissa* Hall. Comp. also with *S. plicata* Hall, (XIII Reg. Rep., *p.* 90) and *S? costata* Owen, (Surv. Wis. Minn. & Io., Tab. III, Fig. 11).

STROPHODONTA IMITATA.—Adductor bosses prominent, bicrescentic, with a short, stout, median ridge issuing from between them forwards. Otherwise resembles S. *inæquistriata*, except that the striæ are nearly equal, and the shell is relatively shorter and only 12.7 mm. (.5) to 17.8 mm. (.7) broad.

STROPHODONTA CINCTA.—Size and general appearance of *S. inæquistriata.* Hinge-line less than greatest width. hinge-angles rounded. Inside of ventral valve minutely pustulose in all parts, and marked by a prominent ridge all around near the border. Divaricator scars diverging, reaching two-thirds the distance to the anterior border; retractor scars nearly as long.

SPIRIFERA BIDORSALIS.—Resembles *S. biplicata* and *bimesialis*, but is not produced at hinge extremities; has a high incurved ventral beak, and delicate, regular imbricating lamellæ. Length 8.88 mm. (.35); breadth 12.7 mm. (.5). Very commonly parasitic on corals.

SPIRIFERA CONSORS.—Semicircular, with salient hinge extremities, ventricose to the margin. Dorsal valve with little elevated but strongly isolated fold, having a median furrow throughout its whole length; ventral, most ventricose, especially near the incurved beak; having a broad, sharply-rounded, well-defined sinus reaching to the beak and destitute of a median ridge. Dorsal area narrow; ventral elevated, arched and perforated by a triangular opening half as broad as high. Surface with about seven rounded plications each side of the middle, and crossed by feeble lines of growth.

Length 11.68 mm- (.46); breadth 21.6 mm. (.85); depth of both valves 11.22 mm. (44).

Less mucronate, more ventricose, and with fewer plications than *S. subattenuata varicosa* and *bimesialis.* Much more ventricose than *S. bidorsalis.* Apparently identical with an undescribed species from Columbus, Ohio.

SPIRIFERA FILICOSTA.—Form and two-thirds the size of *S. Parryana* Hall. Fold and sinus much less pronounced and, with the fewer plications, marked by numerous radial striæ. Ventral beak much incurved; area not well defined.

MARTINIA ATHYROIDES.—Triangularly terebratuliform, without fold or sinus. Ventral valve nearly twice as deep as the other, with a projecting, somewhat incurved beak. No true area, but a broad, triangular fissure extends to the apex of the beak. Shell-structure thin-lamellar—neither punctate nor fibrous. Incremental surface markings numerous, fine, regular. Length 14.22 mm. (.56); breadth 13.21 mm. (.52). Resembles *Charionella Circe* Billings, from Corniferous limestone, but the beak is not perforate.

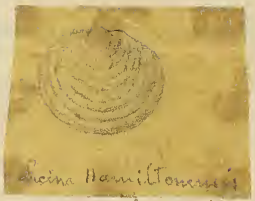
SPIRIGERA EBOREA.—General appearance of small specimens of *S. concentrica*, but more ventricose, with a fuller and more produced ventral beak. Shell substance extremely solid and ivory-like, but not punctate; surface polished, with numerous extremely delicate concentric striæ. Length 9.4 mm. (.37); breadth 9.14 mm. (.36); depth of ventral valve 4.06 mm. (.16).

MERISTA LENS.—Quadrate-rotund, lenticular, both valves equally convex, the ventral having the beak closely incurved over its opposite. Ventral sinus only represented by a slight anterior projection; dorsal fold only a broad angulation of the valve, except anteriorly. Surface of casts marked by six narrow, remote, radiating ridges around the middle of each valve, bifurcated nearer the margin, (vascular markings ?) Occlusor scars ligulate, deep. Shell thick, fibrous. Spires present. Length and breadth 19.81 mm. (.78).

See cast of interior [illegible]

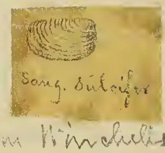
TREMATOSPIRA? LINIUSCULA.—Form and size of *T. perforata* Hall. Cast with numerous faint radiating lines. Ventral beak incurved, apparently imperforate. Dental lamellæ two-fifths the length of the valve. Occlusor scars oval, deep. Dorsal valve with a transverse narrow area; false area of ventral valve with a triangular fissure extending to the beak. Fold and sinus reaching the beak, but very feeble.

PENTAMERUS INTRALINEATUS.—Size of *P. occidentalis* Hall, but broader and more regularly (though faintly) costate on the anterior two-thirds, with shallow ventral sinus reaching to beak. Shell-fibres arranged concentrically. Exterior with numerous wavy, sub-lamellose, concentric grooves, and fine intervening striæ; interior with numerous fine, radiating, grooved striæ.



Lucina Hamiltonensis

from Winchells drawing



Sang. sulcifer pr.

from Winchells drawing

LEIORHYNCHUS SESQUIPLICATUS.—Shell having the form of *Spirigera concentrica*, with a more abrupt sinus and fold which, with the faint plications, extend only half way to the beak. About four plications on the fold, and as many on each side. Concentric lines fine and indistinct. Length 8.38 mm. (.33); breadth 9.65 mm. (.38).

TEREBRATULA TRAVERSENSIS.—In form resembling *T. Linklœni* Hall, but broader, with more of a false area on ventral valve, and no trace of sinus. Surface, also, sub-lamellosely striate concentrically, and pores larger, more oval and more remote—their two diameters and their distances being as 4: 7: 6, while in *T. Linklœni* the same dimensions are as 3: 4: 4. Smaller diameter of pores .0321 mm. (.00126); greater .0559 mm. (.00220); the intervening distance from end to nearest end of pore .048 mm. (.00189.) In *T. Linklœni* these dimensions are .0213 mm. (.00084), .0321 mm. (.00126) and .0359 mm. (.00141).

AVICULOPECTEN INTERCOSTALIS.—Nearly circular in outline, compressed; anterior ear (of left valve) large, depressed-convex, strongly isolated; posterior ear small; surface (of cast) with about 36 distinct, rigid, neatly defined ribs alternated with the same number of feebler rays terminating in the middle of the shell; posterior ear and slope feebly costate; anterior ear strongly so; whole surface with fine concentric striæ, stronger on the anterior ear. Length and height 21.6 mm. (.85).

SANGUINOLITES (GRAMMYSIA ?) SULCIFER.—Small, gibbous, oblong; beak sub-terminal, incurved, overhanging a deep lunule; pallial border straight or broadly sinuate; umbonal ridge sub-angulated; surface with 16–20 deep sulci separated by thin lamelliform, non-imbricated leaves. Length of medium specimen 7.62 mm. (.3); height 5.08 mm. (.2); thickness of both valves 3.56 mm. (.14).

LUCINA ? HAMILTONENSIS.—Shell small, circular, appressed; beaks central, small, scarcely exceeding the hinge-line, turned forward. Exterior with 8–10 deep, broad concentric furrows on the body of the shell, and numerous concentric striæ. Length 15.24 mm. (.6); height 13.97 mm. (.55). Smaller, less gibbous and more deeply and broadly sulcated than *L? proavia.*

CONOCARDIUM EMMETENSE.—Abruptly truncate anteriorly, conical posteriorly, constricted behind the beaks, gibbous, ornamented with about a dozen strong ribs, which are cancellated by finer and more numerous concentric striæ—the three ribs on the angle of the truncation stronger than the others. Differs from *C. eboraceum* Hall in the much greater relative relative strength of the ribs.

CONOCARDIUM BIFARIUM.—Small; body of shell rising into a ventricose ridge running nearly at right angles with hinge, with a deep constriction on each side—deepest on rostral side; whole surface costate with rounded ribs which are largest on the rostrate slope of umbonal swell; inside of shell marked by square ribs corresponding to the intervals between the external ones. Exterior also with fine concentric striæ.

EDMONDIA? LEDOIDES.—Elongate-ovate, ventricose, slightly narrowed and appressed posteriorly; ventral margin distinctly but not strongly curved, hinge margin slightly so; beak subterminal, little projecting. Casts with a faint fold running from beneath the beak to the postero-ventral region. Cardinal processes (teeth ?) consisting of one stout and triangular under beak of left valve, and two smaller ones in right valve. Each valve has also a pair of slender divergent lamellar teeth (perhaps "cartilage supports,") exterior to the cardinal ones. Length 25.4 mm. (1.); height 12.19 mm. (.48).

EDMONDIA MACTROIDES.—Hinge structure and principal characters like *E. ledoides*, but shorter, more ventricose, rounded on ventral side, sometimes sub-angulated along anterior and posterior unbonal slopes—especially in old specimens. Anterior and posterior muscular pits rather deep, round-oval, near the beak. Commissure deeply indented anteriorly, beneath the beaks. Exterior marked only by faint lines of growth. Length 14.22 mm. (.56); length of anterior end 4.83 mm. (.19); height 11.17 mm. [.44]; convexity of both valves 9.65 mm. [.38]. Longest specimen 30.48 mm. [1.2].

MURCHISONIA MUCRO.—Small, turreted, of 6–8 rounded whorls isolated by a deep suture, and marked by a relatively broad, raised, bicarinate band along the middle; lip slightly effuse anteriorly; umbilicus small. Height 5.08 mm. [.2]; diameter of base 2.03 mm. [.08].

PLEUROTOMARIA CAVUMBILICATA.—Rather large, deeply and broadly umbilicate, depressed conical, nearly twice as broad as high; whorls 5–6, with subcircular section, the later ones flattened above, suture impressed; exterior of whorls with obliquely transverse lines which, in the umbilical cavity, and sometimes on the base, coalesce into strong ridges. Interior smooth; two or three of the apical whorls often regularly septate. Height 23.88 mm. [.94]; diameter of last whorl 38.61 mm. [1.52].

PLEUROTOMARIA EMMETENSIS.—Higher than broad; whorls 6 to 8, all rounded, marked by a faint median, revolving, narrow band, and fine, transverse, sigmoid striæ. Cast smooth. Height 28.45 mm. [1.12]; diameter of last whorl 22.61 mm. [.89].

PLEUROTOMARIA PARVISPIRA.—Small, depressed; whorls 4 to 5, rapidly enlarging, biangulated, the flattened upper surface at right angles with the flat peripheral, and with the axis of the shell. Surface with faint sigmoid transverse striæ. Height

7.37 mm. [.29]; height of last whorl 6.84 mm. [.23]; diameter of base 9.91 mm. [.39].

Orthoceras pustulosum.—Characterized by having the exterior covered with pustules of varying sizes and unequally distributed.

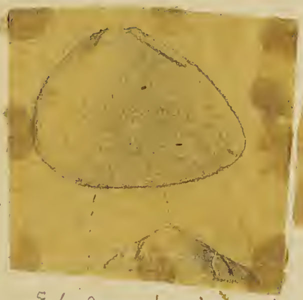
Gomphoceras omicron.—Rather large, compressed-ovate, abruptly constricted at aperture; septa about 12—the last at largest diameter of shell—their distances increasing from 4.57 mm. [.18] near apex to 8.13 mm. [.32] next to last chamber. Siphon large, sub-marginal. Length about 127 mm. [5.]; greater diameter about 76 mm. [3].; smaller 63 mm. [2.5].

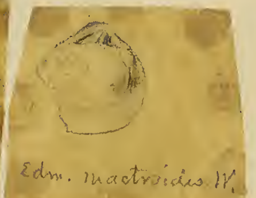
Spirorbis ammon.—Aspect and size of *S. omphalodes* Goldf., but more strictly planorbiform, has uniformly one more whorl, and is less rapidly enlarged.

Spirorbis obesa.—Three or four times the diameter of *S. omphalodes*, consisting of two or three rapidly enlarging, nearly planorboid whorls.

The foregoing is a summary of all that is at present known of the rocks of the Hamilton group on the western side of the lower peninsula of Michigan.

Ann Arbor, 31 July, 1866.





Edm. mactroides W.

From Prof. W's figures.

Ed. mactroides. W

This is certainly a true Schizodus, I should think

6

F. B. Meek
Rec'd March 14th
1870

NOTICES AND DESCRIPTIONS OF FOSSILS, FROM THE MARSHALL GROUP[112] OF THE WESTERN STATES, WITH NOTES ON FOSSILS FROM OTHER FORMATIONS.

By Alexander Winchell, Director of the Geological Survey of Michigan.

The following notices and descriptions were drawn up in March last, but their publication has been delayed by pressing and unremitting engagements, which continued, very unexpectedly, through the entire Summer.

These studies are based chiefly on specimens from Tennessee and Ohio. The Tennessee specimens were submitted (with others) by Prof. James M. Safford, about three years ago, and the conclusions have very recently been announced in his Report on the Geology of that State. The Ohio specimens consist of fossils communicated from time to time, during two or three years past, by Rev. Herman Herzer, and of a series of fossils collected by Prof. E. Andrews, along a section extending from the Blue Limestone, near Cincinnati, along the Ohio river to the Coal Measures,[113] and others collected in Central Ohio and western Pennsylvania.

In order that the references in the following pages may be made intelligible, I subjoin the section communicated by Prof. Andrews:

Section along Ohio river from Adams to Lawrence counties, Ohio.

Coal Measures.

No. 1.	Measures embracing beds of Iron Ore	207 ft.
	Coal, Underlying measures,	157 “
No. 2.	Coarse-grained sandstone of Coal Measures, Clays and Iron Ore,	88 “
No. 3.	“Sub-carboniferous Limestone” of Ky., overlying the “Knobs” of the Kentucky Reports,	46 “

Waverly Series.

No. 4.	Sandstones containing, above, marine plants, *cauda-galli* and other fucoids, and near the bottom, nodules of Kidney Iron Ore. At the bottom is a mass of sandstone and Iron Ore embracing, probably, the fossils of Sciotoville, Flagg's Hill, &c.	258 “
	Sandstones	114 “
No. 5.	Fossiliferous ferruginous sandstone of Rockville, Sandstones with Fucoids, Shales containing the *Goniatites* described by Dr. Hildreth,	127 “
No. 6.	“City Ledge,” 5 ft. above black shale	4 “
	Waverly black shale. Fish-bed, *Lingula subspatulata*, *Discina capax?* Ganoid scales, &c.	16 “
	Lower Waverly beds with Fucoids	127 “

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[112] For other papers by the author, on the Geology and Paleontology of this group, see “First Biennial Report” of the Geological Survey of Michigan, 1860; Amer. Jour. Sci. and Arts [2] vol. xxxiii, p. 352; ib. xxxv, p. 61; Proc. Acad. Nat. Sci., Phil., Sept., 1862, p. 405; ib. Jan., 1863, p. 2; ib. July 1865; Pro. Amer. Phil. Soc., No. 81, (vol. xi) 1869, p. 57; Geology of Tenn., 1869, pp. 364-5 and 440.

[113] This section was read in substance, at the Chicago meeting of the American Association, in Aug., 1868.

No. 7. Ohio Black Shale, embracing beds of fire-clay and *septaria*, 320 "
No. 8. { Buff-colored limestone, arenaceous ("Cliff Limestone") with beds of lenticular Iron Ore near the bottom.
No. 9. Brown and light colored clays (Dr. Locke's "Marl").
No. 10. { Middle or Flinty Limestone, underlaid by yellow clay containing thin layers of limestone.
No. 11. Blue Limestone.

The "Waverly," of Ohio, is regarded by Prof. Andrews, as extending from the "Subcarboniferous Limestone (No. 3), to the "Ohio Black Shale" (No. 7). The Chemung and Portage may be embraced in No. 6.

No. 7 is generally regarded as the equivalent of the "Genesee Shale," of New York.

No. 8 is found to contain the following Niagara species: *Trematopora tubulosa*, Hall; *Caryocrinus ornatus*, Say; *Retepora aspero-striata*, Hall; *Obolus imbricatus*, n. sp.;[114] *strophomena striata*, Hall; *S. rhomboidalis*, Wahl; *S. Niagarensis*, Win. & Mar.; *Hemipronites subplanus*, Con. sp.;[115] *H. hemiaster*, Win. & Mar.; *Orthis elegantula*, Dalm. sp.; *Cornulites flexuosus*, Hall;[116] *Spiriflra sulcata*, Hising, sp; *Atrypa reticularis*, Dalm. A. *neglecta*, Hall; *A. cuneata*, Hall; *Meristella nitida*, Hall, *Pentamerus* sp?; *Platyostoma Niagarense?* Hall,[117] *Orthoceras* sp?; *Dalmania limulurus*, Green sp., *Calymene Niagarensis*, Hall.

No. 9 of Andrews' section contains the following species, some of which are known to belong to the Clinton group: *Rusophycus clavatus* and *bilobatus*, Hall; *Fenestella prisca*, Hall, and *Obolus imbricatus?* n. sp.

It will be noticed that the characteristic fossils of the Waverly Group are traced to near Shafer's, on Oil Creek, Pa., at a locality said to be "200 to 300 feet below the coal," where we find such species as *Chonetes pulchella* Win.; *Lingula membranacea* Win.; *Hemipronites inequalis*, Hall sp.; *Syringothyris typa*, Win.; *Spirifera Carteri*, Hall; *Discina Gallaheri*, Win.; with others common to the Waverly and later formations. At Kinzua, Pa., however, which is stated to be "300 or 400 feet below the Coal Conglomerate," we seem to have passed into the limits of another fauna. Not a single species can be recognized as belonging to the Waverly. On the contrary, *Spirifera disjuncta* (Phillips) Hall, a species of the Chemung Group, of New York, is conspicuous and well determined. Fragments of lamellibranchs which appear to belong to the Chemung species *Avicula longispina* and *acanthoptera*, Hall, are also abundant, as well as a *Rhynchonella*, which differs from any known Waverly species.

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[114] Shell small, nearly circular, with a slightly projecting beak in the ventral valve, false area very small and inconspicuous, central median ridge distinct but delicate, becoming broader anteriorly, and vanishing in front of the centre; a longitudinally oval scar on each side of the central ridge. Surface marked, especially in the older shells, by numerous concentric imbricating lamellae of growth. Transverse diameter 5-16 inch; length of ventral valve about the same. This is a smaller species than *O. Conradi*, Hall, with a more lamellose exterior, and, so far as I have been able to observe, a different cardinal structure.

[115] Several specimens, agreeing very well with the description and figures of New York specimens, but apparently *not* the same as the Illinois specimens referred to this species. (Ill. Geol. Rep III, 349).

[116] The single specimen has the rings somewhat constricted below, instead of regularly convex as in *C. arcuatus* Con.

[117] A carinated shell, more appressed laterally than the carinated varieties figured by Prof. Hall.

It seems, therefore, from these indications, that the line separating the Chemung and Waverly, passes between these two horizons ; and that we have here positive paleontological and stratigraphical evidence of the superposition of the Waverly above the Chemung, as I have heretofore argued.[118]

The fossils from Tennessee identified with species of the age of the Marshall (or Waverly) Group, will undoubtedly be regarded as possessing considerable interest, as this is the first paleontological determination of the extension of this group into that State. They are mostly embraced in a thin deposit of dark, silicious, bituminous shales, emitting an agreeable aromatic odor,[119] and resembling in physical characters, the shales of the Kinderhook Group, of Illinois. This resemblance suggests the belief that the Hickman shales of Tennessee are a prolongation of the Kinderhook shales ; and that they will yet be traced along both sides of the Coal Measures, from Indiana and Illinois across the western extremity of Kentucky.[120]

ZAPHRENTIS IDA? Win. (Proc. A. Nat. Sci., Phil., July, 1865). From Hickman county, Tenn., and Sciotoville, Ohio, (See Andrews' section). The Tennessee specimens are without epitheca, and lack the profound wrinkles of growth belonging to the types of this species, from Rockford, Ind. They also enlarge upward somewhat more rapidly. The Ohio specimen is extremely similar to these.

TREMATOPORA? VESICULOSA, Win. (Proc. A. Nat. Sci., Phil., Jan., 1863, p. 3). Several good specimens from Sciotoville, Ohio.

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[118] See especially Proc. Amer. Phil. Soc., No. 81, p. 57, and Proc. Acad. Nat. Sci., Phil., July, 1865, p. 110.

[119] See further notices of these rocks, Geology of Tenn., chap. XI, sec. I.

[120] Descriptions of these fossils are embraced in the late Report on Tennessee, in a paper embodying notices of some fossils from the "Carboniferous Limestone," of that State. As Prof. Safford has questioned the correctness of my identification of *Spirifera Logani*, I embrace this opportunity to state that I have reinvestigated the question and remain of the same persuasion as before, though I admit there is room for differences of opinion. I have five specimens of *S. imbrex*, (to which Prof. Safford refers the specimens in question) from the typical locality, at Burlington, Iowa. The Tennessee specimens differ from these as follows: They are larger, heavier and coarser shells; the sinus is more deeply sunk, relatively broader, and more distinctly defined, and it is greatly produced in front, while that of *S. imbrex* is scarcely at all produced ; it embraces from 10 to 12 costæ, while that of *S. imbrex* embraces only 6 or 8; the fold, instead of being obsolete, and a mere undefined swell, is raised into a prominent, crest-like, acute ridge, especially toward the front; the dorsal valve is flattened from the middle of the fold to the extremities; the area is not flat, and is striated in both directions; the costæ, besides being smaller, are less numerous, except in very old specimens; they are crossed only by fine concentric striae, and remote irregular grooves, instead of coarse, regular, imbricating striæ raised into nodes on the crests of the costæ, as is the case with the surface of *S. imbrex*, when well preserved.

On the contrary, these specimens agree with *S. Logani*, especially in the following distinctive characters; "Dorsal valve depressed toward the cardinal extremities, and broadly curving to the base; mesial fold very prominent, extremely elevated and subangular in front, not defined at the margins. Ventral valve very gibbous at the sides, marked by a broad, deep, undefined mesial sinus which, in the middle of the shell, occupies fully one-third of the width, sloping abruptly to the cardinal extremities, and extremely produced and elevated in front, in a sub-triangular extension;" the area is concave, vertically and longitudinally striate.

The correct identification of these Tennessee specimens is important, as having a bearing on the question of the equivalencies of the "Silicious Group," of Safford.

LINGULA SUBSPATULATA? M. & W. (Ill. Geol. Rep. III, 437, pl. 13, fig. 1). From Tennessee, and No. 6, Rockville, Ohio. The single specimen from Tennessee, showing the inside of (apparently) the ventral valve, is not over one-third the length of the specimen figured in the Illinois Report; but it otherwise agrees with the description in outline, surface markings, position of beak and faint radiating lines along the middle.

Lingula sub-spatulata was described from the "Black Slate," of Union county, Ill. At Vanceburg, Ky., and other localities on both sides of the Ohio river, is a black shale embraced within the Waverly series, (see No. 6, Andrews' section) which contains a small *Lingula*, not easily distinguishable from the Tennessee specimen. If the Ohio, Kentucky, and Tennessee specimens are really identifiable with the Illinois species, it appears strange that the latter should be found in a geological position so much lower. There seems to be occasion for the query, whether the Illinois equivalent of the Vanceburg Shale has not become confounded with the "Black Shale," by the disappearance of intervening beds; and also, whether the entire mass of the "Black Shale," of southern Ohio, Indiana and Illinois, does not, in fact, belong in a position considerably above the Genesee Shale, as Verneuil, Owen and others long ago suggested.[121]

I am led to suspect that *L. sub-spatulata*, M. & W., is identical with my *L. membranacea*.[122]

LINGULA MEMBRANACEA, Win. (Proc. Acad. N. S., Phil., Jan., 1863). From near Shafer's, Penn.

DISCINA SAFFORDI, n. sp.

Shell rather small, outline nearly circular, but generally a little flattened posteriorly, and also on each of the postero-lateral boundaries. Upper valve rather depressed conical, with the beak midway between the centre and the posterior side; under surface presenting a faint but distinct linear ridge extending anteriorly from the beak one-fourth the diameter of the shell. Lower valve very depressed convex, with an apical pyriform indentation having a blunt spur projecting from its broad anterior end; no perforation visible. Exterior of both valves ornamented with numerous fine, unequal, concentric striæ; interiors smooth, except the faint vascular markings near the borders.

This curious species most resembles in general appearance, *Discina Lodensis*, from the Genesee Shale; but the pyriform indentation of the ventral valve, the finer external striæ and the inconspicuous foramen will serve to distinguish it.

From dark bituminous Shales just above the "Black Slate," of Hickman county, Tennessee.

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[121] The "Black Shale," of northern Ohio, Ontario and Michigan, is undoubtedly the "Genesee," as is proven both stratigraphically and paleontologically. (See Proc. Amer. Phil. Soc., No. 81, p. 77, &c.)

[122] I take occasion to remark that *Gyroceras? Rockfordensis*, M. & W., (Ill. Rep. III, p. 459) from Rockford, Ind., is identical with my *Cyrtoceras Rockfordense*, described in Proc. Acad. Nat. Sci. July, 1865.

Discina Capax? White (Proc. Bos. Soc. Nat. Hist.) From Black Shale (Bed No. 6), Rockville, Ohio.

These specimens resemble *D. Lodensis* in size and markings. They differ in the more prominent and more excentric beak of the dorsal valve. The striæ of *D. Lodensis* are also more regular and more sharply raised, and it is a larger species. It is smaller and thinner than the types of *D. capax*, but I hesitate to pronounce it distinct.

Discina Gallaheri, Win. (Proc. A. N. S., Phil., July, 1865). Collected by Prof. Andrews, at Granville, Licking county, Ohio,—adherent on a *Spirifera;* also, from near Shafer's, Penn.

The Ohio specimens differ from *D. Gallaheri* only in size—being one-half the diameter, or less. The indentation of the dorsal valve is lenticular in outline, and extends nearly from the posterior margin to the centre of the valve. Along the middle of the indentation on the inside is a ribbon-shaped impression, bounded by a sharp, elevated ridge on each side, and divided by a similar, parallel ridge running along the middle of the impression. Each portion of this impression is marked by extremely delicate, raised, transverse lines, which would seem to indicate that the impressions are not the foramen, but a portion of the shell. The foramen may have been a delicate slit occupying the place of the median ridge dividing the two impressions. In *D. Saffordi* the foramen appears to be similarly wanting, and it may have been equally slit-like during life.

The Pennsylvania specimens are mere casts of the non-perforate valve, slightly oval in outline, with irregular, concentric wrinkles, a sub-central beak elevated one-third the smaller diameter of the valve. One of the three casts bears apparently the impressions of the ribs of some costate shell, suggesting that this individual, like the Ohio specimens, may have been parasitic. The larger of these casts are fourteen-sixteenths by eleven-sixteenths of an inch in diameter.

Producta concentrica, Hall (Iowa Geol. Rep. 517, pl. vii, fig. 3; 10 Rep. N. Y. Regents, 180; see also, Winchell, Proc. A. N. S., Phil., July, 1865, p. 115). From yellowish-brown calcareo-argillaceous beds, and from calcareo-silicious shales of Tennessee. Also, from Sciotoville, Ohio.

The Tennessee collection contains one specimen showing both valves, one showing the ventral, and one both sides of the dorsal valve. Another specimen exhibiting the exterior of a ventral valve, resembles the forms named *P. Shumardianus* by Prof. Hall; but this name is probably a synonym of *P. concentrica.*

Producta semireticulata, Fleming.

Collected by Rev. H. Herzer, at Newark, Licking county, Ohio; by Prof. E. Andrews, at Sciotoville (where it is abundant); from bed No. 5, Rockville; from a point 2½ miles west of "Cincinnati Furnace," Vinton county, Ohio (in the upper Waverly); and in large and characteristic specimens from near Shafer's, on Oil Creek, Venango county, Penn.

Producta Cooperensis? Swallow.

From bed No. 4, Sciotoville, Ohio.

There are several specimens of this form, and they differ from specimens of *P. Cooperensis* from Burlington, Iowa, principally in a much shallower ventral sinus and a larger size. In size, and in the peculiar arrangement of the granulations of the inner surface, they resemble *P. duplicostata*, Win., but the costæ are less developed, and there are fewer spines distributed over the general surface. These forms resemble, not a little, *P. viminalis*, ~~Hall~~ White, from the Burlington Limestone, but the costæ are less pronounced, and the ventral valve enlarges less rapidly. This is possibly the species which has sometimes been referred to *P. Cora*, D'Orb.

PRODUCTA GRACILIS? Win. (Proc. Acad. N. Sci., Phil., July, 1865.) From bed No. 4, Sciotoville, Ohio.

The numerous casts from this locality do not preserve the striations as strongly as the types of this species; but they are too broad for *P. parvula*, and the ventral valve is not sufficiently produced. It is desirable yet to make comparisons with specimens of *P. minuta*, Shum.

PRODUCTA MORBILLIANA, Win. (Phil. Proc., July, 1865, p. 113.) From bed No. 4, Sciotoville, Ohio.

PRODUCTA ARCUATA, Hall (Iowa Rep. 518, pl. vii, fig. 4, a. b). Quite abundant in bed No. 5, Rockville, Ohio. Quite identical forms occur also at Granville, O.

CHONETES MULTICOSTA, Win. (Proc. A. N. S., Phil., Jan., 1863, p. 5.) In yellowish-brown calcareo-argillaceous beds and dark bituminous shales in Hickman and Maury counties, Tennessee.

There are two dorsal valves in Prof. Safford's collection. They agree with this species, except that the striæ are considerably more obscure than even in the typical specimens; and the external surface is minutely granulated.

This species ranges from the base of the Yellow Sandstones, at Burlington, Iowa, into the base of the Burlington Limestone.

CHONETES PULCHELLA, Win. (Proc. A. N. Sci., Phila., Sept., 1862.) A single ventral valve occurs among the specimens from Tennessee. It exposes only the inside, and hence the number of ribs cannot be satisfactorily ascertained. A slightly divergent spine appears at each extremity of the hinge line.

Several clearly marked specimens from Newark, Ohio, occur in Prof. Andrews' collection. These exhibit, however, three or four hollow spines each side of the beak.

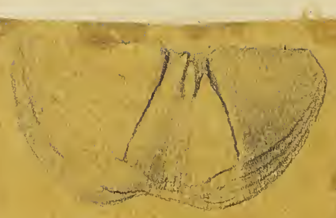
Other specimens from near Shafer's, on Oil Creek, Pa., are almost perfectly identical with these.

CHONETES FISCHERI, N. & P. (Jour. A. N. S., Phil., vol. I). From dark bituminous shales, Tennessee.

CHONETES GENICULATA? White (Proc. Bos. Soc. N. Hist. IX, 29). From bed No. 5, Rockville, Ohio.

The few imperfect specimens in the collection agree with forms occurring at Burlington, Iowa, in the Yellow Sandstones, and sometimes referred with doubt to *C. geniculata*. I suspect they may all prove to be *C.*

Prof. Winchell marked the drawing from which this was traced. Sp. Waverlyensis.



sp. Waverlyensis, W.

pulchella, Win. The type-specimens of *C. geniculata* are from Clarksville, Mo., and, besides presenting the characteristic geniculation in the ventral valve, appear to have a rather shorter hinge line than these specimens.

CHONETES ILLINOISENSIS, Worthen (Trans. St. Louis Acad. Sci. I, 571). Occurs in bed No. 5, Rockville, Ohio.

HEMIPRONITES INEQUALIS, Hall sp. (Io. Geol. Rep. 490, pl. ii, fig. 6, a—c.) Collected by Rev. H. Herzer, at Newark, Ohio, and by Prof. Andrews, at Granville. Collected, also, by the latter in Pennsylvania, near Shafer's.

HEMIPRONITES UMBRACULUM? Schloth. (Die Petrefact. I, p. 256, and II, p. 67.)

Collected by Rev. H. Herzer, at Newark, Ohio, and by Prof. Andrews, in bed No. 4, at Sciotoville and bed No. 5, Rockville, and also, near Shafer's, Penn.

It may well be doubted whether the large specimens ranging through the equivalents of the Marshall group, in the Western States, really belong to the foreign species to which they have generally been referred.

ORTHIS SUBELLIPTICA? W. & W. (Bos. Proc. VIII, 292.) From bed No. 4, Sciotoville, Ohio. A single imperfect specimen.

ORTHIS MICHELINI? L'Eveillé.

From bed No. 5, Rockville, Ohio; from Granville, Licking county; from Vinton county; and also, from near Shafer's, Penn.

The specimens from all these localities agree with each other and with specimens commonly referred to *O. Michelini*. It is a form probably identical with that from Clarksville, Mo., referred to *O. Vanuxemi*, by Prof. Hall. The smaller, flattened specimens approximate *O. flava*, Win., from the Burlington Sandstone, while a large, transversely oval specimen from Rockville, approaches *O. resupinata*, except in much smaller size. In the considerable convexity of some of the dorsal valves (especially from Shafer's), and also in the cast of the muscular scars, they differ from *O. impressa*, Hall. If there are any permanent specific distinctions among the widely extended American forms commonly referred to *O. Michelini*, it will require extended and careful comparisons to make them out.

SPIRIFERA HIRTA? White & Whitfield.

The single specimen from silicious Shales, Tennessee, is considerably larger than specimens from Burlington, Iowa, the typical locality, and perhaps the area is a little more extended laterally.

SPIRIFERA EXTENUATA, Hall (Iowa Rep. 520, pl. vii, fig. 6). Collected by Rev. H. Herzer and Prof. Andrews, at Newark, O.

SPIRIFERA WAVERLYENSIS, n. sp.

Shell semi-circular, without plications (on the cast). Ventral valve with an elevated, nearly flat, transversely furrowed and vertically striated area, reaching the whole length of the hinge-line, which is scarcely less than the greatest width of the valve. The plane of the area forms a right angle with the plane of the valve. Surface more rapidly convex near the margin than between the beak and the middle; lateral slopes, also, gently convex. Sinus deep, well defined, occupying nearly one-fourth the width of the valve, slightly produced anteriorly. Dental lamellæ extending three-fifths the length of the valve, not approximated at the rostral extremity. Muscular scars striate. Surface of cast destitute of plications, but deeply marked toward the front by wrinkles of growth.

Transverse diameter, one and five-eighths inches; antero-posterior diameter, one inch; height of area, three-eighths of an inch.

This species is more completely destitute of plications than any other in rocks of the same age; and this character, together with the length, width and flatness of the area, renders it necessary to admit it as new.

Spirifera Carteri, Hall (*S. Vernonensis*, Swallow). Very abundant in bed No. 4, Sciotoville, Ohio; rare in bed No. 5, Rockville. A single specimen labelled Granville, is, probably (judging from the matrix), from Sciotoville. Occurs also, near Shafer's, Penn.

Spirifera Marionensis, Shum. (Mo. Geol. Rep., Pt. ii, p. 203, pl. C., fig. 8, a—d.) Several specimens from bed No. 4, Sciotoville, Ohio. These specimens agree tolerably well with the description of this species, and with specimens from Clarksville, Mo. This seems to be a species, however, which exhibits a tendency to graduate on the one hand, into *S. biplicata*, and on the other, into *S. Carteri* Young specimens exhibit a well defined ventral sinus, with about two incipient plications; and having, at this age, sharper dorso-lateral angles, they closely approximate *S. biplicata*. Large specimens, on the contrary, can scarcely be distinguished from *S. Carteri*, save by the less pronounced sinus and fold.

There are, indeed, six species described from rocks of this age, which need to be re-examined and compared, viz: *S. Marionensis*, Shum., 1855; *S. Carteri*, Hall, 1857–8; *S. biplicata*, Hall, 1858; *S. Vernonensis*, Swallow, 1860; *S. Osagensis*, Swal., 1860; and *S. Missouriensis*, Swal., 1860. The three first are, perhaps, distinct species—possibly all the others.

Spirifera subrotundata, Hall (Iowa Geol. Rep., p. 521). From bed No. 4, Sciotoville, Ohio.

On some of the casts no striations are certainly seen, except over a limited space one side of the beak.

Spirifera biplicata? Hall. A single imperfect specimen, from No. 4, Sciotoville, Ohio. See remarks above on *S. Marionensis*.

Spiriferina solidirostris, White (Bos. Jour. VII, 232). Collected by Rev. H. Herzer, at Newark, Ohio, and by Prof. Andrews, from bed No. 4, Sciotoville, and bed No. 5, Rockville.

+ Syringothyris typa, Win. (Proc. Acad. N. S., Phil.) This species occurs quite abundantly in Ohio. Mr. Herzer and Prof. Andrews have furnished over a dozen specimens from Newark. In bed No. 4, Sciotoville, it forms, with *Spirifera Carteri* and several other species, the principal mass of a highly ferruginous stratum of sandstone. It occurs freely, also, near Shafer's, in Pennsylvania.

From Newark specimens may be worked out good views of both valves, and of the bifariously striated area. Traces of the pseudo-deltidium may also be seen, and it appears that the dental lamellæ are very deep, but the essential structure of the genus does not appear. There is one exceptional

+ Same as S. Carteri, Hall. Regents 10th Rep.

specimen, which may be a dorsal valve distorted by pressure exerted at the hinge extremities. If undistorted, it belongs, evidently, to a distinct species.

In many of the Sciotoville specimens, the fissured tube and other details of the internal structure of the genus are distinctly shown, but there is difficulty in isolating the specimens from the mass.

A specimen in Prof. Andrews' collection from Newark, which has the beak of the ventral valve somewhat less elevated than usual, and the area considerably vaulted, presents on the cast of this valve generic (?) characters which have not before been noticed. The whole width of the broad sinus, in the middle of the valve, is occupied by a pair of very peculiar occlusor scars, separated by the shallow impression of a low median ridge. Each scar appears somewhat like the representation of the head of a sheaf of wheat—the divergent and pendent heads of grain being turned toward the extremities of the shell. The two scars together are an inch broad, and of equal length. These characters recur in a specimen from Shafer's, Pennsylvania.

I have some suspicion that *Syringothyris typa* is identical with *Spirifera capax*, Hall. The principal distinction, so far as I observe, consists in the lobular, anterior prolongation of the ventral sinus of the former. In a specimen having a transverse diameter of 3½ inches, and a height of area of 1⅜ inches, the ventral sinus projects three-fourths of an inch beyond the general front of the shell. All of my specimens present this character; but it does not appear in the description and figures of *S. capax*. As this is a character which probably bears a relation to the age of the shell, it may be that *S. capax* was described from immature specimens. If so, this species should be known as *Syringothyris capax*.

SPIRIGERA HANNIBALENSIS, Swallow (St. Louis Trans. vol. I, p. 649). Several good casts from bed No. 4, Sciotoville, some of which show both valves. Impressions of the exterior are common, showing that this species flourished to luxuriant dimensions. A pair of spines is preserved, with a bit of smooth shell attached.

SPIRIGERA OHIENSIS, Win. (Proc. A. Nat. Sci., Phil., July, 1865, p. 118.) From bed No. 4, Sciotoville, Ohio.

RHYNCHONELLA SAGERIANA, Win. (Proc. Acad. N. Sci., Phil., Sept., 1862, p. 407.) Six specimens from dark bituminous shales, Tennessee. Also, from Newark, Ohio; bed No. 4, Sciotoville; Granville (abundant,) and from "Cincinnati Furnace," Vinton county, where it is of frequent occurrence.

This is a common and widely distributed species. I have heretofore known it from remote parts of Michigan, and from Medina, Ashland, Cuyahoga, Summit and Licking counties, Ohio.

RHYNCHONELLA MISSOURIENSIS, Shum. (Mo. Report II, 204.) From bed No. 4, Sciotoville, Ohio.

RHYNCHONELLA MARSHALLENSIS, Win. (Proc. A. N. S., Phil., Sept., 1862.) From Granville, Licking county, Ohio.

CENTRONELLA? FLORA, n. sp.

Shell broadly ovate, rather rectilinear along the cardinal slopes, broadly and slightly sinuate, or not, along the ventral commissure; general form of each valve a segment of a sphere. Surface of shell very finely and sharply striate both longitudinally and concentrically.

Length, fifteen-sixteenths of an inch; breadth, fourteen-sixteenths; thickness of both valves seven-sixteenths.

This species is broader and less rostrate than *C. Allei*, Win. (Proc. A. N. S., Phil., July, 1865, p. 123,) and also less tumid around the margins, besides being much more distinctly striate.

Though I am not positive of the generic relations of this species, it appears to be congeneric with *C. Allei*. These species are both ornamented with beautiful terebratuloid punctations, and both exhibit the elongated ribbon-like muscular markings on the ventral valve which also characterize the well-determined species *C. Julia*. In one of the specimens referred (provisionally) to *C? Flora*, there is a low, but elongated median septum in the dorsal valve, from which, near the beak, proceeds, on each side, a thin horizontal, longitudinal plate, reaching half the length of the septum. In the ventral valve, the dental lamellæ are feebly developed, and, instead of reaching the inner surface of the valve, they curve toward the median line and join each other, leaving a small space between the transverse septum thus formed and the surface of the valve—being thus a kind of *shoe-lifter septum inverted*,—or, more strictly, a trough-like plate, as in *Camarophoria*, but not, like that, supported by a median vertical plate. It is worthy of consideration whether these distinctive characters are not of generic importance. The structure noticed in this specimen connects *Pentamerus* with *Terebratula*, as *Camarophoria* connects *Pentamerus* with *Rhynchonella*. I reserve the subject for further study.

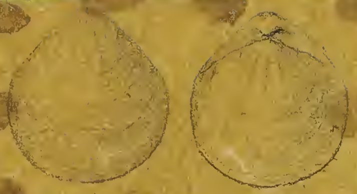
This is a very different type
belonging to a distinct

From bed No. 4, Sciotoville, Ohio.

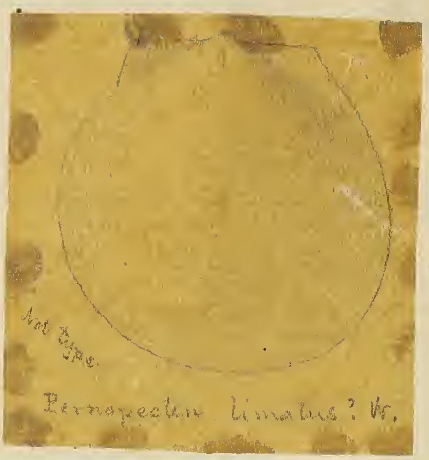
PERNOPECTEN? COOPERENSIS, Shum. sp. (Mo. Geol. Rep., Pt. ii, p. 206, pl. C, 15.) Herzer's collection, Newark, Ohio.

The single internal cast referred to this species is rather too narrow—having about the form of *P. limæformis*. It is marked by about fifteen coarse radiating grooves, with some traces of smaller intermediate ones.

Messrs. Meek and Worthen have expressed a strong suspicion (Ill. Geol. Rep. III, p. 454), that *Pernopecten limæformis* and *P? Shumardianus* are but varieties of *Avicula Cooperensis*, Shum. I embrace the opportunity to correct the impression of these authors that the surface characters of *P. limæformis* have not been seen in a perfect state of preservation. I have impressions of exteriors of this species upon fine (almost lithographic) stone, in which the most delicate characters are much more perfectly preserved than they generally are in fossils retaining the actual shell. Gutta percha restorations from these moulds are perfectly destitute of fine radiating striæ. On the contrary, they exhibit very fine, sharp and regular concentric striæ, and obsolete traces of a few straggling, irregular, discontinuous, broad folds or undulations. This species is also distinctly narrower than the others. With little doubt, its validity should be admitted.

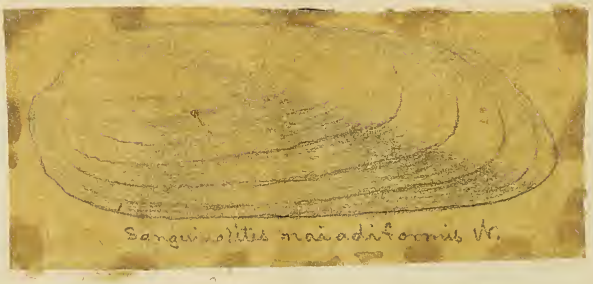


Centron. flora, W.

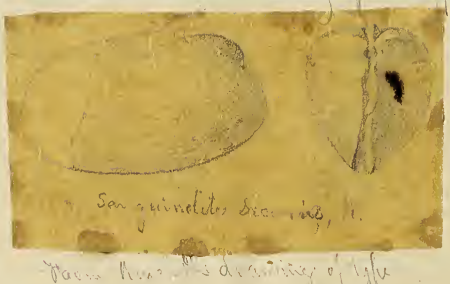

Not type.
Pernopecten limatus? W.

This is an Ohio specimen referred doubtfully by Prof. Winchell to P. limatus. I copied the figure from Prof. Winchell's drawing

For description of the species limatus, see p. 126


Sanguinolites naiadiformis W.

From Winchell's drawing of the type


Sanguinolites [illegible], W.

From Winchell's drawing of type

Pernopecten limatus? Win. (Proc. A. N. S., P., July, 1865, p. 126.) Newark, and bed No. 4, Sciotoville, Ohio.

Like the other Ohio representatives of the species of this family, the specimens of this species are considerably larger than the Iowa types.

Aviculopecten Newarkensis, n. sp.

Dorso-ventral and antero-posterior diameters and length of hinge line as the numbers, 14, 10 and 7. Left valve rather convex, its cardinal slopes forming an angle of about 60°, and thus creating a sharper beak than is usual in this genus. Anterior ear somewhat inflated, with about six strong radiating striæ, finer intermediate ones, and numerous fine decussating striæ. Posterior ear a little smaller, flat, its posterior boundary nearly at right angles with the hinge. Beak scarcely exceeding the hinge. Surface marked with numerous fine, unequal, slightly wavy, delicately crenulated, radial striæ.

Dorso-ventral diameter fourteen-sixteenths of an inch ; antero-posterior, ten-sixteenths ; length of hinge line, seven-sixteenths.

The striæ are of the size of those in *A. tenuicostus*, Win., but they are less rigid, regular and uniform ; the shell is less circular, and the umbo is more prominent.

Aviculopecten Caroli, Win. (Proc. A. N. S., Phil., Jan., 1863, p. 9.) From Newark, bed No. 4, Sciotoville, and from Granville, Ohio.

The specimens from Licking county are all right valves, and are much flatter than typical specimens of the same valve.

Aviculopecten occidentalis, Win. (Proc. A. N. S., Phil., Jan., 1863, p. 9.) From Newark, Licking county, Ohio. The largest specimen is twice the size of the Iowa types. A right valve of the same size, from Granville, shows also obsolete, irregular, radiating furrows around the margin of the cast.

Sanquinolites naiadiformis, n. sp.

Length two and a half times the height ; laterally flattened below the umbo ; dorsal and ventral margins parallel or nearly so—the ventral sometimes with a broad shallow sinus extending upwards over the valves and vanishing near the umbo ; a distinct umbonal ridge flattening out near the postero-ventral angle, at which place the outline presents a rounded angulation ; the postero-dorsal slope making, with the dorsum, an angle of 45°.

Length, $2\frac{3}{4}$ inches ; height, one and one-sixteenth inches ; thickness, half an inch.

The above description is based on a specimen from Hillsdale, Michigan. Mr. Herzer has sent a single specimen from Newark, Ohio, which agrees with this ; but such is the state of preservation of lamellibranchs in this formation, that there is extreme difficulty in ascertaining their generic characters. Another specimen from Granville, Ohio, presents a still better specific accordance.

Sanguinolites (Cypricardia?) securis, n. sp.

Outline of shell sub-oval, anteriorly indented by a small lunule, over which hangs the small, incurved, approximated, sub-terminal beaks. A very prominent, sub-acute ridge runs from the beaks posteriorly and but little below the level of the straight indented hinge line. The greatest thickness of the shell is therefore near the flattened dorsal border. From this ridge the lateral surfaces proceed with slight curvature to the ventral margin, so that the united valves present a cuneate or somewhat axe-like form.

Length, one inch; height, thirteen-sixteenths; transverse diameter, nine-sixteenths.

This species is less elongate than *Cypricardia rigida*, and has a rounded, instead of truncate posterior extremity; the umbonal ridge, also, is nearer the hinge margin.

Collected by Rev. H. Herzer, at Newark, Ohio.

SANGUINOLITES MARSHALLENSIS, Win.

Occurs in bed No. 4, Sciotoville, Ohio.

ALLORISMA (SEDGWICKIA) HANNIBALENSIS, Shum. (Mo. Rep. p. 206). Specimens from Newark, Ohio, agree better with the Burlington (Iowa) forms usually referred to this species, than with Dr. Shumard's figure of the type.

CYPRICARDIA (?) RIGIDA, W. & W. (Bos. Proc. VIII, 300.)

A single specimen from Newark, Ohio, which does not show the "second ridge" between the main umbonal angle and the hinge, and which may result from dorso-ventral compression.

LEDA BELLISTRIATA? Stephens (Am. Jour. Sci. [2] vol. XXV, p. 26.) Five specimens from dark, bituminous Shales, Tennessee, are referred to this species solely on account of external resemblances. They have the peculiar form and sharp concentric furrows of the species. They are a little over an inch in length, but do not, in this, exceed specimens from Battle Creek, Michigan,—the typical locality. At the same time, no indication of hinge-structure has been observed, and the shell seems to have been thinner than usual for the species of this family. Should further discovery demonstrate that these specimens do not belong to *Leda*, they will perhaps fall into the genus *Sedgwickia* of McCoy; but I do not consider it allowable to propose a specific name to be based on discoveries of some future investigator.

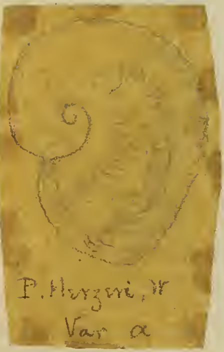
CONOCARDIUM PULCHELLUM, White & Whit. (Proc. Bos. Soc. N. H. VIII, 299.) From Newark, Ohio.

SOLEN SCALPRIFORMIS, Win. (Proc. Acad. N. S., Phil. Sep., 1862, p. 423.) From dark, bituminous shales, Tennessee. Like other species in the same situation, the shell is thin and fragile. This probably resulted from an insufficiency of calcareous matter in the waters which precipitated the argillo-bituminous materials of the rock.

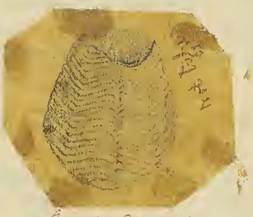
SOLEN QUADRANGULARIS, Win. (Proc. A. N. S., Phil. Jan., 1862.) A fragment from Granville, Ohio.

PLATYCERAS HERZERI, n. sp.

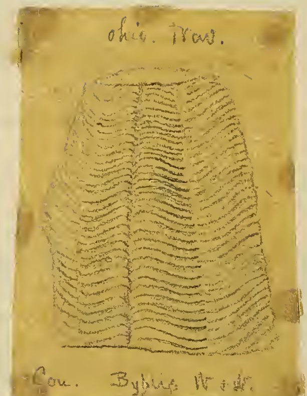
Shell rather large, consisting of about two coils, which enlarge rapidly near the apex, and gradually through the last half of the whorl; laterally compressed, and dorsally sub-angulated, except near the aperture; irregularly plicated longitudinally, and marked transversely by deeply waved, The Allorisma here referred to from Newark and Iowa are probably not the A. Hannibalensis, though this species certainly does occur, in the Waverly of Ohio. I sent sketches of a new species I have called A. Winchelli, to Prof. W. from Newark and Rushville, and he writes that it is the form he had supposed A. Hannibalensis.



From Winchell's figure of the type.



B. Byblis W.



Con. Byblis W & W.

From Prof. Winchell's figure of an Ohio specimen referred by him to White & Whitfield's sp.

lamellar striæ of growth indicating a coarsely and unequally crenate aperture.

Of this species two varieties may be recognized: (A) The typical form, differing from *P. paralium*, W. & W., in its excentric apex; (B) A form less profoundly plicated—perhaps because younger specimens. These forms I was at first inclined to regard as varieties of *P. haliotoides*, M. & W., but I believe the departures are too extreme and the mutually-concurring specimens too numerous for specific identity with the Illinois forms.

P. halioto
is an Ol
type.

The largest specimens, when resting on the aperture, are an inch in height; the transverse diameter of the aperture is five-sixteenths of an inch, and the dorso-ventral diameter six-sixteenths.

Quite abundant at Newark, Ohio.

Platyceras haliotoides, M. & W. (Ill. Geol. Rep. 458, pl. xiv, fig. 3). From Newark, Ohio.

Pleurotomaria Hickmanensis, Win. (Tenn. Geol. Rep).

Globose shells in an incomplete state of preservation, showing regularly convex whorls ornamented with numerous delicately raised and finely beaded revolving striæ, and a well-defined band, without distinct carina. The striæ limiting the band are not beaded, but all the others, on both sides, bear 50 to 60 granulations to the inch. The striæ are quite unequal in number and distribution, since they increase by implantation, with the growth of the shell. The base of the shell is about an inch in diameter, and seems to be perforated by a small umbilicus.

From dark, bituminous shales, Hickman county, Tennessee.

Pleurotomaria vadosa, Hall (XIII. Rep. N. Y. Regents, p. 108.) Numerous casts occur in bed No. 4, Sciotoville, Ohio, which are quite identical with casts from Michigan. Some imperfect moulds, larger than the typical forms, occur also in bed No. 5, Rockville, Ohio.

Murchisonia prolixa, W. & W. (Proc. Bos. Soc. N. H. VIII, 303.) Bed No. 4, Sciotoville, Ohio.

Murchisonia quadricincta, Win. (Proc. Acad. N. S., Phil. Jan. 1863, p. 19.) Bed No. 4, Sciotoville, Ohio.

Bellerophon cyrtolites, Hall. (XIII. Rep. N. Y. Reg.)

A single imperfect specimen from Granville, Ohio.

Conularia byblis, White. (Proc. Bos. Soc. N. H., Feb. 1862, p. 22.) From dark, bituminous shales, Hickman county, Tennessee.

I feel no doubt of the identity of this species. It possesses the same small isolated eminences or granulations ranged in a line along the crests of the ridges, which characterize well preserved specimens from Burlington, Iowa. From 60 to 75 of these eminences may be counted in the space of an inch.

Dr. White does not mention these granulations; only stating, "spaces between the ridges finely crenulate." Worn specimens develop a series of transverse bars between the ridges, which undoubtedly correspond in position with the granulations seen in unworn specimens. Compare with this species, *C. Gervillei* d'Archiac et Vern., Mem. Foss. Rhenish Prov. in Trans. Geol. Soc., Lond., vol. VI, p. 351.

Conularia Newberryi, Win. (Proc. A. N. S., Phil. July, 1865, p. 130.) From bed No. 4, Sciotoville, Ohio.

This shell was probably as large as *C. byblis*. It has the form of a quadrangular pyramid compressed in the direction of two opposite angles. It differs from *C. byblis* as follows:—Its form is much more distinctly angulated; the septa range from 17 to 44 to the inch, while in *C. byblis* they range from 56 to 128 to the inch; it bears a deep V-shaped furrow along each of the angles; within this furrow the septa are deflected abruptly toward the base of the shell, so that they meet from opposite sides at about a right angle; the septa also sweep toward the base with a gentle curve in their extension across the side of the pyramid, by which their centres are about two intervals lower than the portions in the ridge which bounds the angle-furrow. In *C. byblis* the septa-margins also trend toward the base, but they are more nearly straight from angle to centre. The septa, like those in *C. byblis* and many other species, are ornamented along their margins by delicate granulations. The species appears to have been at least three or four inches in length.

The septa toward the upper end become more direct, and I have little doubt that it was the apical portion of this species from which *C. Newberryi* was originally described.

Orthoceras Indianense, Hall. (XIII. Rep. N. Y. Reg.) From Newark and from bed No. 4, Sciotoville, Ohio. One of the specimens from the latter locality exhibits a broad constriction near the base of the outer chamber. From Newark are also fragments of an *Orthoceras* having an elliptic section and oblique septa.

Nautilus (Trematodiscus) trisulcatus, M. & W. (Proc. A. N. S., Phil., 1860, p. 470.) From bed No. 5, Rockville, Ohio.

Goniatites Marshallensis, Win.

From Newark, Ohio. Differs from *G. Lyoni*, M. & W. (=*G. Hyas*, Hall), in having the transverse section regularly curved instead of broadest near the umbilicus; in having the first and second lateral lobes rounded instead of acuminate; in having an additional accessory lobe and saddle, and in having the dorsal lobe broader and relatively longer.

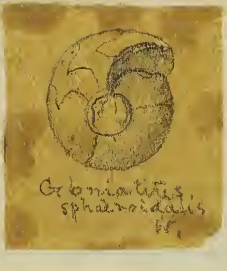
Goniatites Shumardianus, Win. (Am. Jour. Sci. [2] XXXIII, 364, May, 1862.) From Newark, Ohio.

The specimens of this species, though fragmentary, exhibit nearly all the specific characters.

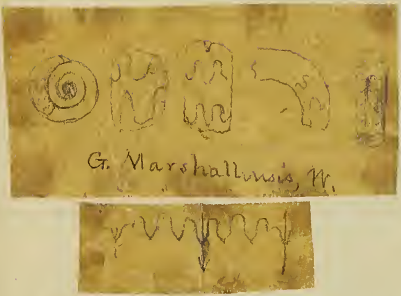
To the description of *G. Shumardianus* originally given, may be added the following characters, drawn from the Newark specimens: Accessory lobe concealed, same form as the lateral one, but only one-third its size, separated by a parallel-sided, circularly terminated saddle from a narrow, elongated, parallel-sided ventral lobe.

As the three species, *G. Allei*, *Shumardianus* and *propinquus*, are closely related in general aspect, their diagnostic characters may be here given in stronger contrast.

G. Allei wants the dorsal lobe—unless we regard the two first-lateral together with the dorsal saddle, as a bifid dorsal lobe—and has a closed umbilicus.



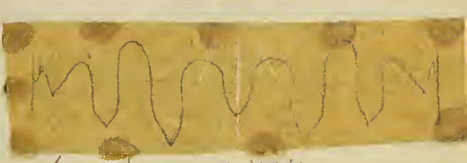
I copied this from a figure among Prof. Winchell's types. He had it marked G. sphaeroidalis, W. but I have been unable to find the description



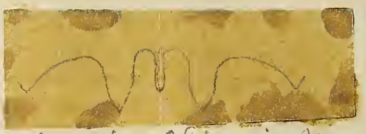
G. Marshallensis, Winchell

The septum is here represented is as seen clear in to the central lobe on the inner or concave side of the whorls

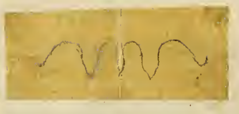
See description on page 13.



G. Lyoni, M & W.
from Winchell's drawing



Goniatites Ohioensis W.
From Winchells drawing



G. Indianensis, W
From Winchells drawing

G. Shumardianus has a simple dorsal lobe and an open umbilicus.

G. propinquus has a shorter and narrower dorsal lobe than *G. Shumardianus*, with a closed umbilicus.

Goniatites Ohi‸oensis, n. sp.

Compressed-globoid, deeply and broadly umbilicate. Dorsum rounded, sides considerably and somewhat obliquely flattened, so as to give the widest transverse section near the borders of the umbilicus, this diameter being to the dorso-ventral as 4 to 3. Dorsal lobe oblong, parallel-sided, obtuse, separated, by a broader and longer, obtusely rounded dorsal saddle, from a subclavate, acute lateral lobe, which reaches half its length behind the dorsal one. This lobe is followed by a very broad shallow saddle having its apex turned obliquely toward the dorsum. Second lateral lobe small, equilaterally triangular, situated on the brink of the umbilicus.

Greatest transverse diameter, fifteen-sixteenths of an inch ; dorso-ventral diameter, twelve-sixteenths; diameter of umbilicus, seven-sixteenths.

Differs from *G. Shumardianus* in its parallel-sided, obtuse dorsal, and linguiform, acuminate first lateral lobe ; also, in the oblique position of the lateral saddle. There is no species likely to be confounded with it unless it be *G. Andrewsi*, which has the sides more convex, and differs also in its acuminate-clavate dorsal lobe.

From Newark, Ohio. Collected by Rev. H. Herzer.

Goniatites Andrewsi, n. sp.

Compressed-globoid; deeply, broadly and abruptly umbilicate. Rounded on the sides, and more rapidly on the dorsum; greatest width close to the umbilicus ; transverse diameter to the dorso-ventral as 4 to 3. Dorsal lobe long, clavate, acuminate, separated by a sub-clavate broadly rounded saddle from the first lateral lobe, which is also clavate-acuminate, but a little broader than the dorsal, and a trifle shorter. This is followed by a very broad, obliquely situated saddle, having its dorsal side concave in the middle, and its umbilical side gently convex. The whorls are marked each by about four constrictions. In one specimen, which seems to preserve a portion of the shell, it is seen to present somewhat uniform, closely-set, transverse wrinkles in the region near the umbilicus. Casts of the umbilicus retain the impression of every whorl to the very apex, and show that this species attained seven or eight volutions, the later of which increased in transverse diameter more rapidly than the earlier.

From Newark, Ohio. Collected by Rev. H. Herzer.

Cythere crassimarginata, Win. (Proc. A. N. S., Phil., Sep.. 1862.) From bed No. 5, Rockville, Ohio. Some of the specimens attain twice the dimensions of the types of the species.

Phillipsia Missouriensis, Shum. sp.

From Newark, Ohio. Collected by Rev. H. Herzer.

All the known characters of the species are exhibited, except the granulations of the surface, which the state of preservation of the specimens renders it impossible to detect.

Phillipsia Tennesseensis, Win. (Tenn. Geol. Rep. p. 445.)

Glabella prominent, indented by a small, round, depressed, posterolateral lobe, and isolated by a deep occipital furrow from a prominent occipital ring, which extends, narrowing in width and curving backwards, entirely across the border, fading out toward the short, acute genal angle. Border concave, bounded by a prominent ridge, outside of which is a linear groove limited peripherally by a sharply elevated, delicate, linear margin. Surface of glabella, accessory lobe and neck-ring covered with fine unequal granulations; a row of granules along the ridge of the border.

Pygidium broadly rounded, nearly twice as broad as long, apparently depressed ; axis with 8 or 9 rings, tapering to the posterior end, which is somewhat abruptly rounded off one-tenth of an inch from the extremity of the pygidium; lateral lobes with 8 or 9 segments becoming obscure posteriorly. Border about one-sixteenth of an inch broad, marked on the under side by nine rigid, sharply impressed parallel striæ. Exterior of the crest very finely and obscurely granulated. Length, about three-eighths of an inch ; breadth, five-eighths.

Other characters of this species are unknown. It seems to approach nearest to *P. articulata*, Hall sp. (XV. Rep. N. Y. Regents, p. 107.) From the Waverly of Ohio ; but is destitute of the anterior and middle furrows of the glabella. Neither does the description of that species give the surface characters, though comparison is made with *Proetus Missouriensis*, Shum., from the lithograpic limestone of Missouri, which is a granulated species. It differs from *Proetus* (*Phillipsia*) *ellipticus*, M. & W. (Ill. Geol. Rep. III, 460), from the Kinderhook group, in the characters of the cephalic border, in the absence of glabellar furrows, and in the border of the pygidium.

From calcareo-argillaceous beds, of yellowish brown color, and from calcareo silicious shales, Hickman and Maury counties, Tennessee.

PHILLIPSIA DORIS, Hall sp. (XIII. Rep. N. Y. Regents, p. 112, and Winchell, Phil. Proc., July, 1865, p. 133.)

Several small pygidia occur in the collection from bed No. 5, Rockville, Ohio.

PLEURODICTYUM PROBLEMATICUM, Goldf.

Well preserved specimens occur at Newark, Ohio. Collected by Rev. H. Herzer.

MURCHISONIA sp?

A fragment nearly three inches long, consisting of four whorls—probably about one or two whorls wanting at the apex and an unknown portion from the other end. The whorls are very oblique, the deeply impressed suture making an angle of 40° or 45° with the axis of the shell. The apical angle of the spire was not more than 18° to 25°. It most nearly resembles *M. quadricincta*, Win., but it has quite a different expression, besides being much larger and having more oblique whorls.

From near Shafer's, Pennsylvania.

From Newark is a *Sigillaria*, and a *Myalina* too imperfect for identification. Two or three species of *Fenestellidæ* occur at Sciotoville, Rockville, and in Licking county. Three species of crinoidal stems exist in Prof. Andrews' collection, from Newark, Granville and Sciotoville. A *Sanguinolaria* occurs at Sciotoville ; and at Granville and Sciotoville is an interesting compound coral with minute tubes, whose specific details are well exhibited, though its generic position is undetermined.

F. B. Meek
March 22d 18

FOSSILS FROM THE POTSDAM
OF
WISCONSIN AND LAKE SUPERIOR.

[From the American Jour. of Science and Arts, Vol. XXXVII, March, 1864.]

Notice of a small collection of Fossils from the Potsdam Sandstone of Wisconsin and the Lake Superior Sandstone of Michigan.

BY PROF. ALEXANDER WINCHELL.

The University of Michigan is in possession of a small collection of fossils from the Potsdam Sandstone of Sauk county, Wisconsin, contributed by one of the *alumni*, Joseph W. Wood. The interest which attaches to every vestige of organic life belonging to this age induces me to offer a few words in reference to the new data in my possession.[1]

Mr. Wood, in transmitting the specimens, writes: * * * "They are found overlying, and in connection with, the "quartzite" of the Devil Lake[2] and Baraboo Bluffs. * * * The quartzite is an indurated sandstone containing ripple marks in abundance—also conglomerates, and, in places, thin layers of talcose slate. It has been upheaved along an east and west axis, * * * the main ridge pushing the Wisconsin river to the east, where it almost forms a junction with the Fox, and at which point the two are joined by a canal. There are many minor ridges, running both parallel and crosswise." About three miles south of the village of Baraboo, the main ridge has been broken open, forming an *anticlinal* valley, in which rests Devil Lake—the semi-stratified quartzite dipping rapidly toward the north-northeast on the east side, and rapidly toward the northwest on the west side, and forming bluffs 450 and 500 feet high on the two sides respectively. The longer axis of the lake is transverse to the main axis of the ridge. South of the bluff, on the east side, and beginning opposite the southern portion of the lake, is a low, level valley, which extends eastward to the Wisconsin river. South of the valley, and bounding the lake at its southern extremity, is a low bluff presenting nearly horizontal stratification; but probably dipping gently southward, since, in the region three or four miles farther south, it supports the first outliers of the Calciferous sandrock.

The high bluffs surrounding the lake are described by Mr. Wood (and also by Prof. Hall in the Wisconsin Report) as consisting entirely of bluish or iron-stained quartzite, exhibiting a gradual passage into an overlying conglomerate, which, in turn, assumes, above, the characteristics of the Potsdam sandstone. Both insist on the absolute continuity and conformability of the quartzite, conglomerate and sandstone. Mr. Wood says: "It is in the northern slope of the main ridge (on the east of the lake) that I found these fossils. If the sandstone containing them shall be called 'Potsdam,' and the main ridge 'Quartzite,' then I should say that they were a continuous deposit; and I do not know of any reason for separating them, only that they differ in hardness; while it is only at the extremes of the scale that this difference is manifest." Prof. Hall states (*Geol. Rep. Wis.* 1862, pp. 11 and 12) that the quartzite is terminated upward by a conglomerate which graduates into the Potsdam sandstone; and agrees with Mr. Wood, that "in some cases the passage from the conglomerate to the sandstone is so gradual that it is impossible to point out a line of demarcation. In the lower part," Prof. Hall further says, "the conglomerate is so destitute of any other materials than the sand and pebbles of the quartzite below, that it bears little affinity to the sandstone above." Nevertheless Prof. Hall is of the opinion that "the quartzite holds the same relative position to the Potsdam sandstone as the Huronian system of the Canada survey."

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[1] The present paper was written and accepted for publication in this Journal before I had become aware of the existence of the very important paper recently issued by Prof. Hall on the Potsdam sandstone of the Northwest. Of the patience and research whose results are set forth in this exhaustive monograph, I here express my great admiration. It will nevertheless be observed that Prof. Hall's monograph does not embrace a notice of any fossils found as far south as those which form the subject of this paper; and I feel that some interest must still attach to the descriptions which are here presented. It will appear evident that a few features have been added to the present paper since the appearance of Prof. Hall's monograph. Other recent information from Mr. Wood has also been incorporated.

[2] Sometimes improperly styled "Spirit Lake."

Some of the fossiliferous fragments forwarded by Mr. Wood contain pebbles three-fourths of an inch in diameter; and I should infer from this circumstance, as well as the position of the fossils upon the northeastern flanks of the bluff, that the remains under consideration occupied a place near the boundary line between the conglomerate and the recognized Potsdam sandstone.

I insist particularly upon the stratigraphical position of these fossils, because they show, contrary to the conclusions of Prof. Hall's monograph, that *Dicellocephalus* and *Ptychaspis* occur at the recognized base of the Potsdam sandstone, as well as above. The alternative of this conclusion is an admission that *the conglomerate and quartzite are truly* (*as they appear to be*) *the downward continuation of the Potsdam sandstone*, and the prolongation of beds which, further north, exhibit a more typical character. If, as I infer from Mr. Wood's communications, the mass of quartzite is superimposed, a little further south, by the outliers of the Calciferous sandrock, this fact would give countenance to the alternative suggested.

SCOLITHUS LINEARIS.

S. linearis Hall, is present in abundance in some of the fragments, in the form of straight, cylindrical, nest-like cavities, two or three inches long, extending vertically to the planes of bedding. They vary from ·05 to ·27 of an inch in diameter.

ORTHIS BARABUENSIS, n. sp.

There are several imperfect specimens of an *Orthis*, apparently of the type of *O. biforatus.* The form is transverse, with a straight hinge-line, and the sub-equal beaks a little elevated above it. Greatest width of shell along the hinge, in front of which the sides are considerably constricted, and continue to approach each other, though less rapidly, to the somewhat straight anterior margin. Ventral valve with a sinus of moderate depth, which is rather broad, and near flat at bottom. Surface with sixteen or eighteen ribs visible on the cast, the strongest of which limit the mesial sinus, which has in the middle a barely visible costal ridge. The interior of this valve exhibits a pair of rudimentary hinge teeth, separated by a triangular foramen. The interior myary scars occupy only a small space near the beak, and present an elliptical outline. The dorsal valve is equally convex with the ventral, and exhibits a broad, depressed mesial fold.

Length of hinge-line ·76 (100); length of shell from beak to anterior margin ·38 (50).

Dr. D. D. Owen (*Rep. Wis. Io. and Min.*, p. 575) and Shumard (*St. Louis Trans.*, i, 627) have made allusion to the existence of this genus in the Potsdam sandstone of the northwest; and a species has just been described by Prof. Hall under the name of *O. Pepina.* Our specimens from Baraboo differ from both this and *O. Coloradoënsis* Shum., in its more transverse shape, fewer ribs and want of concentric lines.

STRAPAROLLUS (OPHILETA) PRIMORDIALIS, n. sp.

A planorboid shell, three-fourths of an inch in diameter, and having the apex of the spire depressed below the level of the outer whorl. The number of whorls is probably about five, but only the last two are preserved in the best specimens. The tube enlarges very gradually, and is marked by a distinct carina just above the peripheral line, above and below which is a shallow groove.

Some of the specimens of this fossil greatly resemble the figure of *Ophileta complanata* Vanuxem, from the Calciferous sandrock of New York; but the volutions enlarge a little more rapidly, and present a distinguishing angulation. No allied species has been described from the Potsdam sandstone (unless it be *O. compacta* Billings, a description of which I have not seen). The *Euomphalus? vaticinus* Hall (16*th Rep. N. Y. Regents*, p. 136) is described and figured as "gently convex above."

PLEUROTOMARIA? ADVENA, n. sp.

A trochoid or sub-turreted shell, of at least four whorls, which are depressed-convex externally, and apparently destitute of all superficial ornaments. But three whorls have been seen; these are ·66 inch in height, and the lower one is about ·77 inch in diameter—the three being of nearly equal height.

This fossil is quite unlike anything described from the Potsdam sandstone; and there is nothing in the Calciferous sandrock which approaches nearer than *Holopea Proserpina* Billings (Pamphlet, Jan. 1862, p. 28), with which this may be congeneric.

DICELLOCEPHALUS MINNESOTENSIS, Owen.

Several specimens occur in the collection which I feel obliged to refer to this species. Some well preserved pygidia do not disagree with Owen's and Hall's (*Foster and Whitney's Rep. on L. Sup. Land Dist.*, pl. xxiii, fig. 30) figures, except that Hall's specimen had lost its caudal flap—a feature well preserved in my specimens, and distinctly reflected upward. Nevertheless, no caudal spines are preserved in any case; and the condition of the specimens would indicate that they were wanting. An imperfect cephalic shield presents a flat border, about as wide as the caudal flap, and, like it, turned slightly upward, and is destitute of a thickened margin. The glabella is truncately rounded in front; the two sides are nearly straight, but not perfectly parallel—being approximated anteriorly at an angle of about 12°. There is at least one furrow extending across the glabella; and in front of this, opposite the anterior extremity of the palpebral lobes, another furrow on each side, reaching less than one-third the distance transversely across the glabella. The course of the great suture in its anterior extension conforms to the requirements of this species.

A doubt may exist whether these specimens are correctly referred, in consequence of the absence of the caudal spines and the defective condition of the posterior portion of the cephalic shield. It seems to me, however, that a pair of blunt spines, in an attenuated peripheral part like the caudal flap, cannot form an indispensable diagnostic character. The direction of the facial suture is exactly that of *D. Minnesotensis*; and the inclination of the sides of the glabella, even if slightly greater than is usual for this species, is not as great as in *D. misa* Hall. The pygidium conforms, in its want of spines, to that of *D. misa*, but the configuration of the glabella and the anterior lobe of the fixed cheek deviate decisively from that species.

DICELLOCEPHALUS PEPINENSIS, Owen.

An imperfect cephalic shield shows a narrow border, with a decidedly thickened margin, which is broader than the furrow between it and the front of the glabella. The glabella is prominent, with sub-parallel sides and an obtusely rounded anterior extremity. Opposite the middle of the prominent palpebral lobes, a furrow passes quite across the glabella, being curved backward in the middle. Behind this is another nearly parallel furrow, and in front is a pair of faint furrows situated nearly opposite the anterior extremity of the palpebral lobe, and each traceable about one-third the distance across the glabella. Another glabella, very similar to this, shows three transverse furrows, besides the anterior interrupted furrow.

A finely preserved pygidium presents a strong convexity, especially in the middle lobe. Aside from the marginal flap, the external outline is nearly semicircular, with the anterior margin considerably curved. The lateral lobes are strongly convex, becoming less so nearer the border, and abruptly joining the caudal flap, at an inclination of about 45°. The pleuræ are furrowed in such a manner that there seems to be an accessory pleura between each two principal ones. The articulations are seven in number in both the axial and side lobes, and extend nearly to the terminal apex of the middle lobe. The caudal flap is flat, and about as wide as the middle lobe at its anterior end, and marked uniformly through its whole length by eight or more rigid concentric striæ. No indications of caudal spines.

This pygidium was originally referred to this species on such information as was accessible, amongst which was Hall's figure in the Wisconsin Report (p. 22, fig. 4), showing indications of a similar striated caudal flap. I am not able by the help of Prof. Hall's last memoir to change the reference, although I perceive the pygidium does not fully agree with the complete characters now published. I am inclined to think this pygidium has not previously been described.

PTYCHASPIS BARABUENSIS, n. sp.

The collection embraces some fragments of the cephalic and caudal shields of a large trilobite, which, while its generic relations are somewhat indeterminate, has a certain expression which is peculiar. The head is about 2·4 inches broad, and rather convex; the thickened and convex margin of the border is separated from the glabella by a narrow, concave furrow, giving the border a width of three-tenths of an inch. Posteriorly, the border is continued in genal points which attain a length not less than three times the length of the glabella. The movable cheek is swollen and separated by a deep transverse furrow from the posterior borders of the cheek. The surface is feebly scrobiculate-wrinkled; though with oblique light it is seen to be distinctly so, and the character is even better shown with a low magnifier, though the cast is preserved in sandstone.

The pygidium which undoubtedly belongs to the same species is 2·9 inches across, and three-fourths of an inch in height. The middle lobe is nine-tenths of an inch across, and is quite prominent, with its posterior portion inarticulate and broadly rounded. There is no limiting furrow separating it from the lateral lobes; and posteriorly it fades insensibly into the terminal border. The lateral lobes are but faintly articulate, and, meeting behind the axis, form a border three-fourths of an inch broad, whch is strongly curved downward on all sides, and presents a ciircularly curved outline, without any indications of caudal appendages.

The foregoing was written before seeing Prof. Hall's memoir; and I had referred the specimens to *Dicellocephalus*, with a query. I could scarcely doubt of their generic distinctness, but felt reluctant to engage in genus-making without ampler materials. I am happy now to recognize Prof. Hall's new genus as exactly meeting my want. This species differs from *P. Miniscaënsis* Hall, in its broader and fuller movable cheek and broader margin, and much longer genal points.

II. The University has for many years been in possession of some fucoidal remains from the red sandstone of the south shore of Lake Superior. As it is so uncertain when any further paleontological data will be obtained from that region, I do not deem it necessary to defer longer a brief notice of these fossil Algæ.

There are two methods of frond-arrangement noticeable among these remains. One exhibits a rudimentary symmetry, while the other is totally destitute of it. There is little difficulty in deciding that neither form falls under any description that has been published; but it is nearly or quite impossible to determine whether these differences are of generic, specific, or still inferior value. The great variation exhibited in the arrangement of the different portions of the fronds of recent marine algæ, shows how little dependence can be placed upon descriptions founded on detached fragments of these fossil fucoids. Those differences which have been sometimes recognized as marking the bounds between distinct genera, may easily have co-existed upon the same frond. There was great plausibility in the method pursued by the older writers in referring all these remains to the single genus *Fucoïdes*.

There seems, nevertheless, some prospect of utility in making such distinctions as we are able; and while I cannot vouch for the generic characters of the fossils under consideration, I shall refer them provisionally to a Paleozoic genus established by Prof. Hall to receive some fucoids from the Calciferous sand-rock of New York.

PALÆOPHYCUS ARTICULATUS, n. sp.

Consisting of large, straight or geniculated, compressed-cylindrical, irregularly articulated, branching stems. The largest stems are an inch and a quarter in diameter; the transverse section oblong, rounded at the ends, or, in other cases, more nearly a circle. The branches are uniformly much smaller than the main stem, and leave it at an angle of about 30°. One of the most marked peculiarities of the species is the somewhat regular transverse constrictions, which occur at intervals of about half an inch, in most of the specimens. At these constrictions the fucoid has shown a disposition to separate, so that most of the fragments present sharply truncate extremities. Surface smooth.

This fucoid is found abundantly scattered over the surfaces of slabs of dark red, fine-grained sandstone, from the north flank of the Porcupine mountains, Lake Superior.

Collected by Dr. Douglass Houghton, in 1840.

PALÆOPHYCUS INFORMIS, n. sp.

Fucoid apparently consisting of fleshy, leaf-like masses, having an irregularly triangular, elongate, or variously amorphous outline. In some instances it would seem that a hollow, conical piece had been compressed so as to present two opposite edges. Sometimes an irregularly elongate piece presents occasional enlargements and tuberculous eminences. There are some indications that the plant was branched, some of which consist in the close approximation of co-adapted edges without complete junction. The surfaces are smooth and shining. The fragments vary from half an inch to two inches in width.

Abundant in dark red sandstone from Montreal river, Lake Superior—a region where Col. Whittlesey estimates the formation to attain the enormous thickness of 15,000 feet. (*Proc. Bost. Soc. Nat. Hist.*, ix, July, 1863.)

Collected by Dr. Houghton, in 1840.

Similar but thinner and more ill defined fucoids occur in red sandstone three miles west of Eagle river; and again in white sandstone near Carp river, on the south shore of Lake Superior.

In associating these remains with others from the Potsdam sandstone of Wisconsin, I do not intend to express any opinion whether the Lake Superior sandstone is of Mesozoic age, as argued by Jackson and Marcou; or of the age of the Chazy formation, as recently concluded by the Canadian geologists (at least in reference to the St. Mary's sandstone); or the prolongation of the lowest fossiliferous sandstones of Wisconsin, as thought by Messrs. Foster and Whitney, and formerly by Hall, and still earlier intimated in the unpublished notes of Dr. Houghton; or finally, as now intimated by Hall, a formation ranging from a horizon below the fossiliferous sandstones of Wisconsin to the top of the Chazy formation or St. Peter's sandstone.

University of Michigan, Dec. 11th, 1863.

8

F. B. Meek
July 29th 1867

SYNOPTICAL VIEW

OF THE

GEOLOGICAL SUCCESSION

OF

ORGANIC TYPES.

By ALEXANDER WINCHELL, M. A.,
PROFESSOR OF GEOLOGY, ZOOLOGY, AND BOTANY IN THE UNIVERSITY OF MICHIGAN.

SECOND EDITION.

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1867.

SYNOPTICAL VIEW.

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Note.—Names of generic and specific value are printed in italics ; of families, in Roman letters, and of higher groups in small capitals. An asterisk affixed to the name of a species or genus indicates that it has survived to the present day.

I. PALÆOZOIC TIME.

First appearance of Organic Life.

Reign of the ancient forms of life, all the species and almost all the genera of which have become extinct.

1. **LAURENTIAN AGE** (Lower Azoic).

First appearance of vegetal and animal life.
Reign of Protozoans and Fucoids.
Period of *Eozoon canadense* (Foraminifer) the sole organism positively known.

II. HURONIAN AGE (Upper Azoic; Cambrian).

First appearance of ZOOPHYTES, WORMS, and CRUSTACEANS.
Reign of PROTOZOANS continued.
Period of PALÆOPYGE (the sole CRUSTACEAN); *Oldhamia* (HYDROID ACALEPH); *Eozoon Bavaricum*.

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III. SILURIAN AGE.

First appearance of well-preserved RADIATES, and, at last, of VERTEBRATES.
Reign of MOLLUSCS–especially Orthoceratites and BRACHIOPODS (Bivalves with central beaks and unequal valves).
Period of TRILOBITES; Orthoceratites; BRACHIOPODS; CYSTIDEANS (CRINOIDS with arms wanting, or central); GRAPTOLITES (HYDROID ACALEPHS); PROTOZOANS.

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Lower Silurian. (*Silurien inferieur*)

1. ST. JOHN'S PERIOD (Lower Lingula Flags; Primordial; Etage C).
First appearance of TRILOBITES, BRACHIOPODS.
Reign of TRILOBITES.
Period of *Paradoxides*, *Conocephalites*, *Arionellus*, *Microdiscus*, *Agnostus* (TRILOBITES); *Orthis*, *Lingulella*, *Discina* * (BRACH.)

2. POTSDAM PERIOD, (Upper Lingula Flags and Lower Tremadoc).
First appearance of GASTEROPODS.
Reign of TRILOBITES continued.
Period of *Olenellus*, *Conocephalites*, *Bathyurus*, *Salterella*, (TRILOB.); *Obolus*, *Obolella*, *Lingula* * *Lingulepis*, *Lingulella*, *Orthisina*, *Camerella*, (BRACH.); *Archæocyathus* (SPONGE); *Scolithus*, *Palæophycus*, *Licrophyous* (FUCOIDS), in the Lower Potsdam; of *Dicellocephalus*, *Ptychaspis*, *Agnostus* and other TRILOBITES; *Pleurotomaria* (GASTEROP); *Orthis*, *Lingula* *, *Lingulepis* (BRACH.) in the upper Potsdam.

3. CALCIFEROUS PERIOD, (Probably most of the Taconic; upper Tremadoc.)
First appearance of TETRABRANCH CEPHALOPODS, LAMELLIBRANCHS, (bivalves with valves equal and beaks not central), *Receptaculites*. (FORAMINIFER).
Reign of CEPHALOPODS, GASTEROPODS, and BRACHIOPODS.
Period of *Nautilus* *, *Lituites*, *Orthoceras* (CEPHAL.); *Pleurotomaria*, *Metoptoma* (GASTER.)

4. LEVIS PERIOD, including Levis proper, Lauzon and Sillery (Lower Llandeilo); 5 CHAZY (Upper Llandeilo); 6 TTENTON; 7 NASHVILLE (Hudson River: Cincinnati).
First appearance of Spiriferidæ, Rhynchonellidæ, Strophomenidæ, (BRACH.); BRYOZOANS; CYSTIDEANS, CRINIDEANS (Fixed CRINOIDS); ECHINOIDS; GRAPTOLITES; ZOANTHARIA TABULATA; ZOANTHARIA RUGOSA (Corals with conspicuous quaternary lamellæ); disappearance of *Maclurea; Olenus*, *Agnostus*, *Ogygia*, *Asaphus;* decline of GRAPTOLITES.
Reign of CHAMBERED MOLLUSCS with simple septa; GASTEROPODS; BRACHIOPODS; Fixed Crinoids; ZOANTHARIA TABULATA (corals with well-developed walls and transverse diaphragms—HYDROID ACALEPHS of Agassiz); GRAPTOLITES.
Period of *Trinucleus*, *Asaphus*, *Illænus*, *Lichas*, *Calymene*, *Agnostus*, *Ampyx* (TRILOB.); *Cyrtoceras*, *Cryptoceras*, *Ormoceras*, *Lituites*, *Orthoceras*, etc. (TETRABRANCHS with simple septa) *Cyrtolites*, *Bucania*, *Maclurea*, *Pleurotomaria*, *Murchisonia*, *Holopea*, *Cyclonema*, *Eunema*, *Subulites*, *Metoptoma*, (GASTEROP.); *Ambonychia*, *Ctenodonta*, *Modiolopsis*, *Pterinea*, *Conocardium*, *Cyrtodonta*, (LAMELLIBRANCHS); *Rhynchonella*, *Stricklandinia*, *Zygospira*, *Orthis*, *Leptæna*, *Strophomena*, *Discina* *, *Trematis* (BRACH.); *Ptilodictya* (BRYOZOON); *Glyptocrinus*, *Heterrcrinus*, *Palæocrinus*, etc., with numerous CYSTIDS (CRINOIDEA);

Palæaster, *Tæniaster*, *Pleurocystis* (Echinoids); *Graptolithus; Favosites*, *Halysites*, *Chætetes*, *Columnaria*, *Tetradium* (Zoan. tab.); *Petria*, *Stromatocerium* (Zoan. rugosa); *Eospongia*, *Astylospongia*, *Astræospongia*, (Sponges) *Arthroclema* (Fucoid). a

Upper Silurian (*Murchisonien*).

8. Niagara Period; 9, Salina (Onondaga Salt); 10, Lower Helderberg.

First appearance of *Homalonotus*, *Phacops* (Tril.); *Spirifera*, *Atrypa*, *Merista*, *Chonetes*, *Crania* * (Brach.) *Actinocrinus*.

Disappearance of Graptolites; *Calymene*, *Illænus*, *Acidaspis; Halysites*. Decline of *Orthoceras*; Cystideans.

Rign of Tetrabranchs with simple septa; Brachiopods; Crinoids; Coral animals.

Period of *Calymene*, *Lichas*, *Acidaspis*, *Illænus*, *Dalmania* (Tril.); *Eurypterus* (Entomostracan]; *Lituites*, *Cyrtoceras*, *Gomphoceras*, *Orthoceras*, *Conularia; Platyceras*, *Platyostoma*, *Subulites*, *Holopea* (Gaster.); *Conocardium*, *Pterinea*, *Modiolopsis*, (Lamell.); *Rhynchonella*, *Pentamerus*, *Sperifera*, *Atrypa* *Merista*, *Meristella* (Brach.); *Fenestella*, *Ptilodictya*, *Phænopora*, *Helopora*, etc., (Bryozoans); *Carycrinus*, *Ichthyocrinus*, *Stephanocrinus*, *Actinocrinus*, *Rhodocrinus*, *Eucalyptocrinus*, *Tentaculites* (Crinoids); *Favosites*, *Halysites*, *Heliolites*, *Cladopora*, *Stromatopora* (Corals); *Ischadites*, *Receptaculites* (Foraminifera).

In the uppermost beds of the Silurian are found, in Great Britain, the small icthyolites called *Plectrodus mirabilis* and *Onchus Murchisonii;* and on the island of Œsel in the Baltic, *Thyestes verrucosus* and *Cephalaspis Schrenkii*. No Silurian Fish-remains are known in America.

IV. DEVONIAN AGE [Old Red Sandstone; *Devonien.*]

Frst appearance of Fishes (in America) and Decapod (10-footed) Crustaceans (in Europe). Culmination of Cyathophylloids.

Reign of Fishes and Coral-animals.

Lower Devonian. 11, Oriskany Period; 12, Corniferous.

First appearance of *Fishes* [in Corniferous]; *Productus;* broad-winged *Spirifers*.

Disappearance of Cystids [in Oriskany]; *Favistella*, *Heliolites*. Decline of Trilobites and Orthoceratites.

Reign of Fishes; Coral-reef Polyps; *Atrypa reticularis.*

Period of the Cup-corals *Cyathophyllum*, *Zaphrentis*, *Clisiophyllum*, *Blothrophyllum*, *Amplexus*, *Chonophyllum* [Zoan. rugosa]; and the other corals, *Favosites*, *Michelinia*, *Syringopora*, *Aulopora*, *Heliolites*, *Haimeophyllum*, *Eridophyllum; Nucleocrinus; Atrypa*, *Spirifer*, *Strophomena*, *Chonetes*, *Productus*, *Pentamerus*, *Leptocœlia*, *Centronella*, *Charionella* [Brach.]; *Conocardium trigonale*, *Lucina* * *proavia; Cyrtoceras*, *Gomphoceras; Dalmania*, *Proetus* [Tril.]; *Macropetalichthys*, *Machæracanthus*, *Onychodus*, *Psammodus*, *Oracanthus*, *Palæoniscus* [American Fishes].

The Devonian Fishes are Cestraciont Sharks * [with bony pavement teeth], and Ganoids of the groups Placoganoids * (Sturgeon-like), Rhombifers * [like the Garpike], Imbricates * (like *Amia*—the fresh-water Dog-fish). All have vertebrated tails; and the Ganoids possess reptilian conformations.

Upper Devonian. 13, Hamilton Period—represented by Marcellus Shale, Hamilton proper and Genesee Shale [Black " Slate" of the West]; 14, Chemung Period [Huron Group of Mich.]—represented

by Portage [Green Shales of Huron Gr.] and Chemung proper [argillaceous and areno-micaceous shales of Huron Gr.]

First appearance of Land Vegetation—represented by LEPIDODENDROIDS, the highest of flowerless plants, and perhaps Conifers, the lowest of flowering plants. Neither Mosses nor Grasses. Also of TETRABRANCHS with lobed septa and dorsal siphon; *Terebratula**.
Disappearance of all the old genera of TRILOBITES; *Atrypa*.
Decline of TRILOBITES, Orthoceratites, *Strophomena*, Orthis.
Reign of FISHES; *Spirifer mucronatus*, *Atrypa*, *reticularis*, *Spirigera concentrica*.

Period of *Lepidodendron*, *Sigillaria*, *Noeggerathia*, *Sagenaria*, *Calamites* [Land plants]; Coral-reefs; *Heliophyllum*, *Cystiphyllum*, *Diphyphyllum*, *Favosites*, *Alveolites*, *Cœnostroma*, *Idiostroma*, *Stromatopora*, *Trachypora*, *Striatopora*, *Fistulipora*, *Callopora*, *Chætetes* [CORALS]; *Nucleocrinus*, *Dolatocrinus*, *Rhodocrinus*, [CRINOIDS]; BRYOZOA; *Atrypa*, *Chonetes*, *Productus*, *Spirigera*, *Cyrtia*, *Strophomena*, *Strophodonta*, *Spirigera*, *Retzia*, *Terebratula**, *Rhynchonella**, *Discina**, *Lingula**, *Crania** [BRACH.]; *Grammysia*, *Orthonota*, *Pterinea*, *Aviculopecten* [LAMELL.]; *Bellerophon*, *Pleurotomaria*, *Platyceras*, *Euomphalus*, *Loxonema* [GASTER]; *Goniatites*, *Orthoceras*, *Clymenia*, *Gomphoceras* [TETRABRANCHS]; *Spirorbis**; *Phacops*, *Dalmania*, *Proetus*, *Arges*, [TRILOB.] *Cypridina* [ENTOMOSTRACAN]. Also the American fishes *Macropetalichthys*, *Coccosteus?* *Pterichthys?* and numerous European genera.

Spirorbis in Carbonifera

NOTE 1. The "Catskill Group," so far as distinct from the *Chemung*, is probably included in the WAVERLY. It contains *Holoptychius* (Fish), *Euomphalus*, *Edmondia*, *Cypricardia*.

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2. In Scotland, there occur, in beds generally regarded Devonian, the remains of *Telerpeton Egininense*, an acrodont, amphicœlian, lizard-like REPTILE, associated with remains of the reptilian *Stagonolepis* and *Hyperdapodon*. These beds, however, are suspected to be Triassic.

V. CARBONIFEROUS AGE [*Carboniferien*].

First appearance of REPTILES (at least in America); INSECTEANS; BARNACLES; GYMNOSPERMS.

Reign of PLACOID and GANOID FISHES; CRINOIDS; ACROGENOUS PLANTS.

Period of Actinocrinidæ; Cyathocrinidæ; Cyathophyllidæ *Nautili**. The bizarre Fishes of the Devonian have been replaced by more normal types.

Lower Carboniferous. 15, WAVERLY PERIOD [Conglomerate of Western N. Y.; Marshall, Mich.; Chouteau, Mo.; Kinderhook, Ill.; Yellow Sandstone, Io., etc.]; 16, MOUNTAIN LIMESTONE—represented by the Burlington, Keokuk, Warsaw [Chester] St. Louis and Kaskaskia Limestones [Knobstones, Ia., Ky.; Silicious Group, Tenn.]. The Waverly rocks are clearly embraced in the Mountain Limestone series of Europe.

First appearance of ~~*Palæoniscus*~~, *Hybodus* [FISHES]; *Phillipsia*, *Griffithides* [TRILOB.]; Oysters; Comatulidæ [FREE CRINOIDS]; and in America, of REPTILES.

Disappearance of TRILOBITES, *Atrypa reticularis*, *Strophomena rhomboidalis*, *Pentamerus*.
Decline of Strophomenidæ, *Orthis*.
Reign of Productidæ, *Spirifer*, *Spirigera*; *Goniatites*; Blastoids; Palœchenoid; CRINIDS.
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Period of Pentremitidæ [Crinids without arms]; *Actinocrinus, Platycrinus, Zeacrinus, Poteriocrinus, Strotocrinus, Steganocrinus, Gilbertsocrinus, Taxocrinus, etc.* [armed Crinids]; *Archæocidaris, Melonites, Palæchinus* [Echinoids]; *Archimedes, Fenestella, Coscinium, Cyclopora, Polypora* [Bryozoa]; *Lithostrotion, Zaphrentis, Sphenopoterium, Conopoterium, Favosites, Leptopora, Syringopora* [Corals]; *Productus, Chonetes, Spirigera, Spirifera, Retzia, Syringothyris, Terebratula** [Brach.]; *Solen *, Mytilus *, Myalina, Pterinea, Aviculopecten, Pernopecten, Eumicrotis, Dexiobia, Ostrea *, Sanguinolaria, Ctenodonta, Arca** [Lamel.]; *Straparollus, Pleurotomaria, Loxonema, Holopella, Naticopsis, Machrocheilus, Platyceras, Dentalium*, Bellerophon* [Gaster.]; *Nautilus *, Orthoceras, Phragmoceras, Goniatites, Cyrtoceras* [Tetrabranchs]; *Phillipsia, Griffithides* [Tril.]; multitudes of Selachian Fishes with pavement teeth, and with sharp teeth, and Ganoids with rhombic and with imbricated scales; *Sauropus primævus* [Amphibian, in Pa.]

Upper Carboniferous. 17, Coal Measures—represented by [a] false coal measures, [b] conglomerate, [Parma congl.; Bonaventure congl.]; [c] Coal Measures proper, intersected by Mahoning and Anvil Rock Sandstones; 18, Permian [*Permien*].

First appearance of Enaliosaurian and Lacertian Reptiles; Insects, Spiders, Myriapods; Tetradecapod, and [in America] Decapod Crustaceans; Hybodont Sharks.

Disappearance of Trilobites, Orthoceratites [in America]; Cyathophylloid corals; *Goniatites; Orthis, Productus, Chonetes,* Stro*phomena* [Brach.]; *Favosites.*

Decline of vertebrate-tailed Ganoids; Crinoids; *Leptæna.*

Reign of Acrogenous Plants; Ganoid and Selachian Fishes.

Period of Coal Plants [low Conifers; Sigillarids; Calamites; Acrogenous Cryptogams]; *Fusulina* [Protozoan]; *Cyathaxonia* Cup Coral]; *Poteriocrinus, Actinocrinus, Erisocrinus,* etc. [Crinids]; *Archæocidaris* [Echinoid]; *Fenestella* [Bry.]: *Spirifera, Spirigera* [*Athyris*], *Syntrielasma, Productus, Chonetes* [Brach.]; *Arca, Sanguinolites, Aviculopecten, Pinna, Eumicrotis, Mytilus *, Myalina,* [Lam.] *Bellerophon, Pleurotomaria, Naticopsis, Machrocheilus, Murchisonia, Loxonema, Orthonema, Soleniscus, Pupa *,* [Gaster.]; *Nautilus *, Goniatites, Cyrtoceras, Orthoceras* [Tetrabr.]; *Spirorbis** [Worm]; *Phillipsia* [Tril.]; *Bellinurus, Acanthotelson, Palæocaris, Anthrapalæmon* [medial and higher Crustaceans]; *Beyrichia, Cypris ** [Ostracoids]; *Xylobius, Anthracerpes* (Myriapods); *Blattina* [Orthopterous Insect]; *Miamia, Hemeristia,* [Neuropters]; *Palæocampa,* [Lepidopter?]; in Europe a Coleopter; numerous Ganoid, Cestraciont and Hybodont, Fishes; *Raniceps, Dendrerpeton, Thenaropus, Amphibamus* [Labyrinthodont Amphibians]; *Hylonomus* [Lacertian]; *Eosaurus,* [Enaliosaur]. These reptiles are all American. Reptiles become more abundant in the European Permian. No Angiosperms, Mosses, Lichens or Liverworts yet existed.

II. MESOZOIC TIME (Secondary.)

First appearance of Mammals; Birds; Turtles?; Teliost (or common) Fishes; Dibranchiate Cephalopods: Astræoid Corals; Angiosperms and Palms.

Reign of Reptiles; Ammonitidæ (Tetrabranchs with foliated septa); Belemnitidæ (Dibranchs); Echinoids (Sea Urchins); Asterioids (Star Fishes); Cycads.

Culmination and Decline of Reptiles, Molluscs and Gymnosperms.

Period of Zoantharia Aporosa (foliaceous corals); Zoantharia Perforata (corals with perforated walls).

VI. TRIASSIC AGE.

Trias : 19, Bunter Sandstein [*Conchylien* in part]; 20, Muschelkalk [*Conchylien* in part]; 21, Keuper [*Saliferien*].

First appearance of Mammals; Turtles?; *Ceratites*, *Ammonites*, Pycnocrinidæ [shallow cupped Crinoids].

Disappearance of *Orthoceras*, *Goniatites;* Heterocercal Ganoids.

Reign of Saurian and Labyrinthodont Reptiles; *Ceratites;* Cycads.

Period of *Dromatherium*, *Microlestes* [Insectivorous Marsupials, —the last European]; *Rutiodon*, *Clepsysaurus*, *Centemodon*, *Bathygnathus* [Saurian Reptiles]; *Nothosaurus* [a marine Saurian]; *Labyrinthodon* [allied to the frog and crocodile]; Ganoids, including some with homocercal [equally lobed] tails; Insects; *Nautiloceras*, *Orthoceras* [in Europe], *Melia*, *Ammonites*, *Conchorhynchus*, *Ceratites* Tetrabranchs]; numerous Lamellibranchs; *Spirifer*, *Terebratula**.

The footprints in the Connecticut river sandstones are regarded as Triassico-jurassic.

VII. JURASSIC AGE.

Eirst appearance of Dipterous and Hymenopterous Insects (flies and bees); Squalodonts.

Disappearance of vertebrate-tailed (heterocercal) Ganoids; Labyrinthodonts; Spiriferidæ; Strophomenidæ.

Reign of Reptiles; Hybodonts; Ammonitidæ; Belemnitidæ; Free Crinoids; Decapod and Isopod (equal-footed) Crustaceans.

Period of *Pentacrinus*, *Apiocrinus;* Corals; Star-Fishes; Echinoids; *Terebratula**, *Rhynchonella*;* *Ostreidœ;* *Ammonites*, *Belemnites;* Insecteans; Crustaceans; Worms; Ganoid Selachians; Enaliosaurs; Lacertians; Crocodilians; Deinosaurs (the highest reptiles); Pterosaurs (flying reptiles); Turtles. Fishes proper (Teliosts) are still wanting.

22. Lias :—represented by *Sinemurien*, *Liasien* and *Toarcien*.

First appearance of Pterodactyls; Lepidoids [mostly obtusely-toothed Ganoids]; Sturgeons; Chimæroids [an order of Sharks]; *Belemnites;* *Thecidea* [Brach.]; *Planorbis**, *Paludina**, *Melania**.

Disappearance of *Spirifer*, *Leptœna*.

Reign of *Ichthyosaurus* [12 species]; *Plesiosaurus* [12 species]; Hybodonts [Sharks with conical, striated teeth].

Oolite : 24. LOWER OOLITE [Inferior Oolite or *Bajocien*, and Great Oolite or *Bathonien*) ; 24, MIDDLE OOLITE [Oxford Clay or *Callovien* and *Oxfordien ;* Coral Rag or *Corallien ;* 25.UPPER OOLITE [Kimmeridge Clay or *Kimmeridgien* and Purbeck and Portland Beds or *Portlandien*].

First appearance of ACRODONT SAURIANS (Lizards with teeth soldered to the jaws] and, in Europe, of Free [stemless] Crinoids*.

Reign of PTERODACTYLS ; GANOIDS ; PLACOIDS ; MACROURAL [lobster-like] DECAPODS ; Free Crinoids ; ZOOPHYTES.

Period of *Phascolotherium* and *Thylacotherium* [MARSUPIALS] ; and of ICHTHYOSAURIANS.

26. Wealden [*Neocomien*].

First appearance of web-footed BIRDS [NATATORES] culmination of the type of REPTILES.

Reign of DEINOSAURIANS, viz : *Megalosaurus* [40 feet in length] *Iguanodon* [60 feet], *Pelorosaurus* (80 feet), and *Hylæosaurus ;* and of CROCODILIANS.

VIII. CRETACEOUS AGE.

First appearance of ANGIOSPERMS [more than 100 species] and PALMS ; BRACHYURAL (crab-like) DECAPODS ; CYCLOIDS [soft-finned] and CTENOID (spinny-finned) FISHES ; true *Crocodiles**; GRALLATORES; WHALES. Decline of CEPHALOPODS ; ICTHYOSAURS ; PLESIOSAURS; DEINOSAURS.

Reign of *Ammonites* ; REPTILES ; Rudistes ; BRYOZOA ; ECHINOIDS ; FORAMINIFERA ; SQUALODONTS (sharks with sharp teeth) ; Oysters.

Earlier Cretaceous : 27, DACOTA GR. ; 28, BENTON GR. ; 29, NIOBRARA GR.

Period of *Liriodendron**, *Quercus**, *Cornus**, *Fagus**, *Populus**, *Salix**, *Alnus**, *Sassafras**, *Liquidambar**, *Taxodium**, (ANGIOSPERMOUS trees) ; Oysters ; ASTERIOIDS ; Ammonitidæ.

Later Cretaceous : 30, PIERRE GR. ; 31, FOX HILLS GR.

Period of Ammonitidæ ; Belemnitidæ; Oysters ; NAUTILUS*, *Terebratulina ; Mosasaurus* (a marine, carnivorous, acrodont lizard) ; *Crocodilus* ; Lamna**, *Otodus*, *Oxyrhina*, (SQUALODONTS) ; *Ptychodus* (CESTRACIONT) ; *Priscodelphinus* (CETACEAN) ; RHIZOPODS; few corals.

[In Europe the Cretaceous is divided into GREEN SAND : consisting of LOWER GREEN SAND (*Aptien*) ; GAULT (*Albien*) ; UPPER GREEN SAND (*Cenomanien*) and WHITE CHALK: consisting of LOWER WHITE CHALK (*Turonien*) ; UPPER WHITE CHALK (*Senonien*); MÆSTRICHT (*Danien*). The Green Sand Stage seems to be wanting in America.]

III. CENOZOIC TIME

Dawn and culmination of the present order of nature.

Reign of MAMMALS.

IX. TERTIARY AGE.

First appearance of SERPENTS and of nearly all the orders of MAMMALS and BIRDS.

Reign of MAMMALS ; SHARKS.

Introduction of REPTILES and FISHES approaching to existing forms. The DEINOSAURS, PTEROSAURS, ENALIOSAURS, Am-

monitidæ and Belemnitidæ have disappeared. All the mammalian species are extinct.

Period of all the types of CRUSTACEA except the highest (MAIOIDS); TELIOST and SQUALODONT FISHES; TURTLES; CROCODILES.

32. Claiborne [Lower Eocene; *Suessonien*].

Period of ANGIOSPERMS, CONIFERS, PALMS—mostly of existing genera, and resembling Miocene plants of Europe; LAMELLIBRANCHS in great abundance.

33. Jackson [Middle Eocene; *Parisien.*]

Period of LAMELLIBRANCHS; GASTEROPODS; *Zeuglodon* (whale-like, 70 feet long).

34. Vicksburg (Upper Eocene, Lower Miocene of some; *Falunien inferieur* ou *Tongrien* and upper part of *Parisien*).

Period of Diatomaceæ (Silicious PROTOPHYTES); ANGIOSPERMS; CONIFERS; PALMS; *Orbitoides*; LAMELLIBRANCHS.

[The Eocene of Europe witnessed the first appearance of QUADRUMANA (Monkeys); Dogs (being the oldest CARNIVORA); CHEIROPTERA (bats): Squirrels; CETACEA (whale-like); of RAPTORIAL (predaceous), SCANSORIAL [climbing], RASORIAL [scratching], and INSESSORIAL [perching] BIRDS. Reign of FORAMINIFERA; SHARKS; CROCODILES. Period of *Nummulites; Palæotherium*, *Anoplotherium*].

35. Yorktown (Miocene; *Falunien superieur*).

First appearance of Cats; Rats; Seals; INSECTIVORA; EDENTATA; RUMINANTIA [cud-chewers]; *Mastodon.*

Reign of CARNIVORA and UNGULATA (hoofed animals).

Great increase of MAMMALS—in Europe CARNIVORA and odd-toed UNGULATES; in North America, odd and even-toed UNGULATES; in S. America TOXODONT and PROBOSCIDEAN (elephant-like) UNGULATES.

Period of the "Bad Lands" of Dakota which have afforded 8 CARNIVORES; 25 HERBIVORES, includidg 2 *Rhinoceroses* and species approaching the *Tapir*, *Peccary*, *Deer*, *Camel*, *Horse;* and 4 RODENTS. On the Atlantic coast, *Whales*, *Dolphins*, *Seal*, *Walrus.*

36. Sumter (Pliocene; Older Pliocene of Lyell; *Subappenin*).

First appearance of Bears; soft-shell Turtles; CURSORIAL [ostrich-like] BIRDS; Camelidæ.

Reign of PACHYDERMS [thick-skinned quadrupeds]; EDENTATES (incisors, and generally, canines, wanting); *Mastodon.*

Period of RHIZOPODS; *Stag; Andrias Scheuchzeri*, a Salamander once mistaken for a fossil man. In the Upper Missouri region, 27 species of MAMMALS, all extinct, including forms referred to *Camel*, *Rhinoceros*, *Mastodon*, *Elephas imperator*, *Horse*, (4 or 5 species), *Deer*, *Musk-Deer*, *Oreodon*, *Wolf*, *Fox*, *Beaver*, *Porcupine.*

X. POST-TERTIARY AGE (Quaternary).

First appearance of nearly all the existing genera of terrestrial animals. First invertebrate Fauna nearly all the species of which have continued to exist; their living representatives now inhabiting more northern latitudes. Quadrupeds nearly all extinct.

[illegible]

37. Glacial Epoch [Drift; Newer Pliocene or Pleistocene, Lyel; *Subappenin* in part, D'Orb.)

In America no fossil animals.

Reign, on the Eastern continent, of boreal MOLLUSCS and huge QUADRUPEDS,

Period of *Tigers*, *Hyenas*, *Bears*, *Lions*, *Wolves*, *Weasels*, *Foxes*; also of extinct species of *Elephant*, (*E. primigenius*) *Hare*, *Rhinoceros*, *Horse*, *Hippopotamus*, *Ox*, *Deer.*

38. Champlain Epoch [Laurentian, Desor; Post-Pliocene, Lyell; Pleistocene, Morris and others; *Subappenin* in part, D'Orb.]

Reign of gigantic MAMMALS and BIRDS.

Period of MOLLUSCS of northern species; *Elephas Americanus*; *Mastodon giganteus; Horse, Ox, Bison, Tapir*, gigantic *Beaver, Dicotyles, Bear, Lion, Raccoon, Megalonyx; Whale* (near lake Champlain); and probably of the pampean, Megatherioid EDENTATES, viz: *Megatherium, Glyptodon, Megalonyx, Mylodon, Scelidotherium*. The *Dinornis, Palapteryx* and *Aptornis*—extinct gigantic BIRDS of New Zealand, and the *Epiornis* of Madagascar, perhaps belong here. The dominant types in the Orient, were CARNIVORES; in North America, HERBIVORES · in South America, EDENTATES; in Australia, MARSUPIALS.

39. Terrace Epoch [Human; Recent; *Terrains contemporains.*]

First appearance of MAN and the Fauna and Flora contemporaneous with him. The new species were much smaller than their predecessors of the Champlain Epoch. The *Elephant, Rhinoceros, Cave Bear* and *Hyena, Irish Elk*, and a few other Mammals of the Champlain Epoch continued into this.

Disappearance of the *Dodo*, the great *Auk*, and perhaps of the *Dinornis, Epiornis*, etc., as well as *Mastodon giganteus, Elephas Americanus*, etc'; also of *Rytina Stelleri* (a Manatee); *Bos primigenius* (Ure-Ox of Europe).

Reign of MAN.

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surprise to the inhabitants to learn peaches, apples, grapes, pears, raspberries, strawberries, and other fruits, can be cultivated with success. The discovery has given a wonderful impetus to this branch of enterprise; and, unless my judgment greatly misleads me, we shall hear of the Grand Traverse region, within ten years, as the fruit-orchard of the country; and shrewd men, with horticultural tastes and a moderate amount of means, will thank me for directing attention to this open avenue to wealth.

P. S. — Since the foregoing paper was read, I have been informed by Dr. I. A. Lapham, of Milwaukie, that the themometer sank at that place only to —30° on the first of January, 1864. I have also received his chart of the summer and winter isothermal lines which cross Lake Michigan, showing that the lake affects the climate very perceptibly, even in the region lying to the westward. In comparing the meteorological *means* of Traverse City, therefore, with localities in Wisconsin and Minnesota, the contrasts, though well marked, are not so salient as if the comparisons had been made with localities quite removed from the interference of the great lakes. The windward position of Wisconsin, however, during our coldest storms, would prevent the *extreme minima* of the climate from receiving any alleviation from the proximity of the lake.

2. STROMATOPORIDÆ: THEIR STRUCTURE AND ZOÖLOGICAL AFFINITIES. By Prof. ALEXANDER WINCHELL, of Ann Arbor, Michigan.

A RECENT investigation of the organic remains of Little Traverse Bay, in the State of Michigan, has caused my attention to be directed to the nature and zoölogical relations of the Goldfussian genus *Stromatopora*. Without attempting to present a synopsis of the literature of the subject, or even to enter upon a full discussion of the organic nature of the beings embraced under the genus, I desire to present a few suggestions, based on some interesting facts that have come under my observation.

The genus *Stromatopora* was first briefly characterized by Goldfuss about the year 1827 (Petrefacta Germainæ, I., p. 21), in the following words: —

"*Polyparium hemisphæricum s. subglobosum, e stratis solidis et fungoso-porosis alternantibus contiguis.*"

The first species described was *S. concentrica* from the Devonani limestone of the Eifel: "*S. stratis concentricis infundibuliformis undatis.*"

Save that the author seems to have contemplated the object in an inverted position, and thus to have figured it, the description of this species will apply to a large proportion of the massive *Stromatoporæ* that have been since observed. Accordingly we find that authors have been in the habit of referring to this species a wide range of distinguishable forms from various different formations.

In his remarks upon this species, Goldfuss says, it sometimes attains a diameter of several feet. The funnel-form layers fit into each other in such manner that the inner and upper gradually become smaller and flatter. The outer are generally undulated. All together form, with their outcropping edges, the even, concentrically furrowed upper surface of the coral-body. With a magnifier one is able to discover that the basis of the thicker beds is a complicated net-work, while the spongy intervening beds are composed of coarse interwoven fibres.

At a later period (Petr. Germ. I., p. 215), the learned author presented the results of his investigation of the various forms which he brought together under the name of *Stromatopora polymorpha.* He remarks that while the study of the former species had led him to associate it with true corals, giving it a position between millepores and madrepores, his later studies led him to range *Stromatopora* under the sponges. *S. polymorpha* was described as being primarily a thin incrustation of spongy matter deposited upon a coral, shell, or other submarine body, preserving on its exterior all the inequalities of the supporting body. Upon this successive layers of similar matter were deposited, until the organism assumed its destined form, and the primitive body dissolved away, leaving a cavity in its place. Partly through the inequalities of the primitive body, and partly through the unequal deposition of the successive spongy layers, the surface became tuberculated, warty, or even cylindrically or ramosely elevated. Through weathering and attrition, the summits of these eminences became worn down through one or more of the layers, so as to exhibit concentric rings. The summits and their vicinity acquire chinks or fissures, as the learned author expresses it, which penetrate the first beds of the net-work, and thus form vermicularly diverging furrows. The apex of the tubercle is frequently perforated by a hole, which, in some instances, is considerably enlarged and surrounded by one or more series of smaller holes.

This organism, in its various states of growth and weathering, presents the varied forms which the author had previously described as *Tragos capitatum*, and *Ceriopora verrucosa*, — in some instances, also, bringing out the characters of *Mermecium* and *Siphonia*, — facts which lead him to conclude with the just reflection that in the classification of organic bodies we must be guided by the essential organic structure; for mere surface physiognomy is capable, as in this case, of leading to the admission of several genera within the limits of even a single species.

In 1839 Lonsdale, besides characterizing a new species (*S. nummulitisimilis*), having a flattened, discoidal form, from the Wenlock limestone, identified *S. concentrica*, from the Wenlock limestone and shale (Silurian System, pp. 680–1, pl. xv., figs. 31 and 32). The latter was properly made a new species by D'Orbigny in 1847, under the name of *S. striatella*, in consequence of the much greater compression of its layers (Prodrome de Pal. I., p. 51); and this change was adopted by McCoy in 1851 and by Murchison in 1859 (Siluria, p. 210). It is a massive coral, like *S. concentrica*, and is generally represented as growing around some submarine organic body.

In 1847 Prof. Hall characterized the genus *Stromatocerium* to receive an obscure species from the Black River limestone, which he named *S. rugosum* (Pal. N. Y., I. p. 48, pl. xii., fig. 2). Judging from the description and figures, this fossil is completely congeneric with *Stromatopora concentrica*, and has been so regarded by D'Orbigny, Pictet, Billings, and others.

In the same year, D'Orbigny separated the tuberculated and mammillated forms of *S. polymorpha* as constituted by Goldfuss, and established for their reception the new genus *Sparsispongia* with the species *S. polymorpha*, *radiosa*, and *ramosa* (Prod. de Pal. I., p. 109).

Pictet has admitted this genus and made it the type of a tribe of sponges (Paleónt. IV., p. 548), while McCoy indentifies it with *Caunopora* of Phillips.

In 1851 Prof. McCoy investigated *Stromatoporæ*, and controverted, the general impression that they are sponges, since the whole mass, being composed of rigid, though vesicular, curved plates, would be incapable of those systolic and diastolic motions essential to the life of a sponge. On the other hand, he detected in the intercellular structure of *Palæopora*, *Fistulipora*, etc., something analogous to the vesicular structure of *Stromatopora*, and thought he discovered, also, some faint indications of the existence of individual polyp cells. He accounted for the absence of cell-walls by the supposed exserted position of the polyp, as in *Goniopora*. He accordingly places *Stromatopora* in the *Tubiporidæ*, near *Fistulipora* (Brit. Pal. Foss., p. 12). He regards *Caunopora* as a sub-genus of *Stromatopora*.

In 1862 Mr. Billings described a second species — *S. compacta* — from the Black River limestone (Paleozoic Foss., p. 55), which differs from *S. rugosa* as *S. striatella* does from *S. concentrica*. Mr. Billings first ranged these organisms under Amorphozoa, but from later examinations he states that he was led to regard them as corals allied to *Fistulipora* (Ib., p. 213).

It may be further stated that Geinitz places a portion of the *Stromatoporæ* under Madrepora (Versteinerungs-kunde, p. 580), and others under Nullipora (Ib., p. 583); Agassiz places them under Milleporina (Nomenclator Zoöl.); Bronn, under Bryozoa (Index, Pal. II., p. 1203); Pictet, under Spongiaires (Paleont. iv., p. 556); while Dana, in one instance, ranges *Stromatopora* under Bryozoa (Man. Geol., p. 191), and in another, under Radiates (Ib., p. 240).

I now proceed to give the results of my own observations upon the four species discovered in the Hamilton group of Michigan and Ohio, and recently described in my report on the "Grand Traverse Region," pp. 90–1.

Stromatopora pustulifera is a species which occurs in large, spheroidal, ovoid, or elongate masses, composed of arching, transverse, concentric layers formed of laminæ of coralline substance, separated by a net-work of minute passages, which, at intervals, coalesce and turn upwards through the bed, radiating and ramifying again on its upper side. The places where the beds are thus traversed are raised, on the upper side, into little eminences. The distinction into beds is produced by variations in the density of the coralline substance. Masses of coral occur, several feet in length, and even in diameter. The distance of the pustules 4 millimetres, or .16 inch; and the mean thickness of the laminæ one-fifth of a millimetre, or .008 inch.

Stromatopora monticulifera has a structure and form like the preceding, but differs therefrom in the much larger and more remote eminences on the upper surfaces of the concentric beds, and in the larger and more distinctly radiating character of the passages which diverge from the apices of the monticules. These passages, on the exposed surface, are little, flexuous, somewhat branching furrows, which diminish in size and disappear within 5 millimetres or .2 inch. The distance of the monticules is from 7 to 10 millimetres. This coral attains a diameter of at least 3½ metres or 12 feet. I have found it in Little Traverse Bay, on the west side of the State; on Thunder Bay Island, on the east side; and on Kelly's Island, near Sandusky, Ohio.

The two species thus described evidently possess some affinity with the verrucose forms embraced by Goldfuss under *S. polymorpha*, and separated by D'Orbigny under his genus *Sparsispongia.* The distinct, vermicular perforations suggest, also, an affinity with *Caunopora*, Phillips. The great regularity and persistence of the eminences, however, render it impossible to account for them, as Goldfuss did, by an unequal deposition of coralline substance, or by original inequalities in the primitive body upon which the corallum was formed. Indeed, though I have seen ship-loads of these corals, I have never detected evidence that they were in any sense incrusting. The concentric layers are only segments of circles passing transversely across the spheroidal, or more often elongated mass, — many of which I have seen standing erect in the face of an escarpment, with the ruins of other beings and other generations strewn around them. The *débris* of these organisms have formed literal coral reefs, and constitute, in Little Traverse Bay, almost the entire mass of a bed of buffish limestone twenty-five feet in thickness.

Neither can I agree with Goldfuss, that the radiating furrows and perforations are caused by attrition or disintegration of the apica portions of the eminences. They are always most distinct on the freshly exposed surfaces, and show as well on the under side as the upper side of the layers.

The third species which I have described is *Stromatopora nux.* This occurs in moderate-sized spheroidal, sometimes contiguous and coalesced masses, formed, unlike the foregoing species, by accretions on all sides, and is often seen to be parasitic. The external surfaces of the layers are not pustulose. Masses occur from 2½ to 12 centimetres, or 1 to 5 inches, in diameter. This species has also been recognized on Kelly's Island.

This is one of the species commonly referred, in this country, to *S. concentrica,* Goldf.; but I do not believe that species exists in America. *S. nux* differs from *S. concentrica* in the same manner that *S. striatella* does; but the latter is an Upper Silurian and a European species, and I should hesitate to unite it with *S. nux.*

Lastly, a most unexpected and remarkable form has come under my observation, which I have described as *S. cæspitosa.* In general *ensemble* it looks like a large, cespitosely branching Cyathophylloid coral. The stems are externally in contact, or 15 to 25 millimetres apart. A longitudinal section shows the characteristic layers arching across the stem and resembling *S. pustulifera* in miniature. A transverse section exhibits a radiating structure, as in *Cyathophyllidæ;* but there is no outer wall or definite limitation to the structure, and the interior is completely filled with concentric circles of coralline substance, except a small perforation in the centre. The exterior is longitudinally vermicular-striate. Diameter of stem 4½ to 7½ millimetres, or .18 to .30 inch. It occurs in masses from 6 to 9 decimetres, or 3 to 4 feet in diameter.

I think there can be no doubt that this species conforms to *Stromatopora,* as defined by Goldfuss and McCoy. It possesses the concentric and reticulated layers of *S. concentrica, pustulifera,* and *monticulifera.* It is not enveloping, like the former, but presents an exaggerated condition of the unwalled pile of layers characterizing the two latter species. On the contrary, the *ensemble* is that of a Cyathophylloid, and traces of radial, lamellar lines are actually present, producing irregular longitudinal striæ on the exterior. It seems to possess, therefore, undoubted affinities with those genera of *Cyathophyllidæ* in which the mural system is feebly developed, and the diaphragms and lamellæ tolerably well represented. In short, it seems to exhibit a transition from *Stromatopora* proper to *Cyathophyllidæ.*

The affinities of this species with *S. pustulifera* and *monticulifera* carry the two latter also into the group of Zoantharia. These two species, moreover, in their regularly distributed eminences, with their apical perforations and vermicularly radiating channels, preserving a vertical relationship of structure, in straight lines, through hundreds of the concentric layers, show that their upper surfaces have been locally and regularly differentiated through individualized portions of the sarcoid mass. In other words, each eminence answers to a polyp-cell. The radiating channels have some reference to a septal system, which in *S. cæspitosa* comes into still more visible existence. The diaphragms become confluent in contiguous polyp-cells, as in *Dania* and some other genera, and as becomes the case with the lamellæ of *Smithia* and *Phillipsastræa.* In *S. concentrica* we have a more degraded condition of the same fundamental structure. The specialization of the surface is visibly wanting; the septal system is only obscurely shadowed forth by the reticulated passages between the spongy layers; the common polyp mass becomes little more than a simple sarcode, resting on the upper surface and filling the subjacent interstices; and, finally, its low organization is further signalized by its parasitic habit and its tendency to flow around and attach itself to all sides of its support.

It must be admitted that such forms as have been referred to *Sparsispongia* possess characters in common with other genera, commonly included among sponges, such as *Chenendopora*, Lamouroux, and *Forospongia* and *Verrucospongia*, D'Orbigny; and the radiating furrows may even be compared with those of such solitary forms as *Cnemidium rotula* and *mammillare*, Goldf. (Petr. Germ. Tab. VI., figs. 5 and 6), and *Siphonia præmorsa*, Goldf., as figured by Hisinger (Petrif. Svec. Tab. XXVI., fig. 7); but these affinities, instead of drawing our *Stromatoporæ* toward Amorphozoa, only raise the question whether the affiliated genera are not also sufficiently related to polypi to fall under a particular family of Zoantharia.

For reasons set forth above, I should agree with Agassiz and McCoy in placing the *Stromatoporæ* amongst Zoantharia, but I should differ with both in deciding upon their local affinities. Agassiz seems to have placed them in Milleporidæ, governed by the minutely vesicular structure of the mass; homologizing this with the cellular structure of the cœnenchyma of Millepores; while, in my own view, these corals are destitute of cœnenchyma, and their vesicular tissue is endo-structural, and ought to be homologized with that of *Cystiphyllum*, or perhaps more properly with the vesicular zone of *Cyathophyllum* and *Heliophyllum*. McCoy has also viewed this vesicular tissue as intercellular, in ranging *Stromatopora* by the side of *Fistulipora*. But it differs from *Fistulipora* and *Palæopora* as well as the *Milleporidæ* in general, in the absence of the mural system and the confluence of the diaphragms of contiguous individuals.

It is true that the great predominance of the septal system is capable of suggesting very strongly a subordination to the type of Zoantharia tabulata; but the want of a mural system shows a divergence equally great, and a corresponding affinity with the Aporosa, and exceptional cases of the Rugosa with which I associate them; while the general affinities of the species which I have discussed throw a great weight of evidence in support of their Cyathophylloid relationship.

It is evident that the different species of *Stromatopora* which have been brought under discussion present three distinguishable plans of detailed structure: —

1. We have the cæspitose, completely individualized form, retaining traces of lamellæ. This is evidently most nearly related to *Cyathophyllidæ;* and I am not aware that it has been noticed by any author.

2. The forms with the confluent but not obliterated individualities, preserving the diaphragms, but losing the lamellæ, represented by *S. polymorpha*, Goldf., *Sparsispongia*, D'Orb. The name proposed by D'Orbigny could be retained for this type, if it were not a clear misnomer.

3. The forms with confluent and obliterated individualities. These embrace the original type of the genus *Stromatopora.*

The forms described under the name *Caunopora*, Phillips (Pal. Foss. t. x.; fig. 29, etc.), notwithstanding McCoy's suggestion, seem to be sufficiently distinct from *Sparsispongia*, and should probably constitute a fourth generic type holding position next above *Stromatopora* proper.

If the views presented above prove to be tenable, we shall have the following arrangement and diagnoses of *Stromatoporidæ:* —

Family Stromatoporidæ. — Polyps isolated or confluent; exserted, never forming a cup; secreting a corallum which consists of a series of concentric layers (or diaphragms) of vesicular tissue, separated and perforated by vermicular, ramifying passages, which are either radially or confusedly disposed. Mural system wanting; lamellar structure distinctly present only in the higher forms.

Genus, *Idiostroma*, (n. g.) — Polypi completely isolated, forming branching masses; lamellar system, represented by a radial structure.

Species, *I. caespitosum*, *gordiaceum*.[1]

Genus, *Cœnostroma*, (n. g.) — Polypi confluent, but individualized, forming elongated, or spheroidal, compound masses; diaphragms common and continuous throughout; lamellar system indicated by the radiate arrangement of the vermicular passages which commonly diverge from the summits of little eminences raised in the concentric laminæ.

Species, *C. pustulosum*, *monticuliferum*, *granuliferum*,[2] *polymorphum*, *radiosum*, *ramosum*.

Genus, *Caunopora* [3] (Phillips). — "Corallum polymorphous, composed of minute, irregular, vermicular, cellulose tissue, disposed in obscure concentric layers, traversed by few long, larger, variously disposed, vermiform, cylindrical channels." (McCoy, Brit. Pal. Foss, p. 66.)

Species, *C. placenta*, *ramosa*, *verticillata*.

Genus, *Stromatopora* (Goldf.)— Polypi confluent, with individualities sensibly obliterated. Corallum consisting essentially of confluent diaphragms, or concentric layers, which generally inclose a foreign body, —being secreted on all sides of it and forming a spheroidal mass.

Species, *S. concentrica*, *striatella*, *nux*, *rugosa*, *compacta*, *nummulitisimilis*.

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[1] *Idiostroma gordiaceum* (n. sp.) — In general appearance resembles *I. cœspitosum*. The stems, however, are intricately entangled, and radial lamellæ have a distinct existence; thus showing a still nearer approach to the Cyathophylloids. A very interesting species from Iowa City, Iowa.

[2] This species occcurs at Charleston Landing, Indiana, a few miles above Jeffersonville. It differs from *C. pustulifera* in having the upper surface of the layers more minutely pustuliferous or granulated.

[3] It is yet desirable to compare authentic specimens of this type with specimens of *Idiostroma*; though, if, as McCoy asserts, its affinities are with *Sparsispongia* (from which I think it differs materially), it is a very different type from *Idiostroma*.

C. PRACTICAL SCIENCE.

1. On the Link of Gunter's Chain as the Unit of a Decimal System of Weights and Measures. By B. S. Lyman, of Philadelphia, Penn.

The object of this paper is to call attention to the fact of our having already in use a decimal system of measures, and to the feasibility of its general extension.

In replacing our ordinary measures and weights by new decimal ones, it is less important to have the same unit with other countries than to have easy means of converting the old measures into the new; for conversion from one decimal system to another is comparatively easy, and it is chiefly importers and travellers and readers of foreign books alone who need to compare foreign measures with ours. Of all measures land measures will need for the longest time to be frequently converted from the old standard to the new, on account of the great length of time that a land deed remains in use; and they also require most time for us to learn to conceive of them accurately.

If the link of Gunter's Chain, a measure widely used by land surveyors, and familiar, also, to most land owners, were taken for the standard unit of a decimal system, the important denominations of link, chain, furlong, and acre would remain absolutely unchanged. The link is 7.92 inches, and is within a twentieth of an inch of one-fifth of the French metre. Ten links are six feet and 7.2 inches, and might be called a fathom, since there are so many fathoms in use as to make it hitherto a rather indefinite length; and this fathom would be almost exactly equal to two metres, or to the Saxon Lachter. The mile might be lengthened so as to be ten furlongs (nearer than our present mile to the geographical mile), and then a square mile would contain 1000 acres. Since the link is about eight inches, or two hands, one tenth of it might be called a finger, and it would be almost exactly the length of the (theoretical) diameter of the new five cent. coin. One hundredth of a link is $\frac{95}{100}$, or $\frac{19}{20}$ of the present line, and might be called a line.

A cubic link contains 497 cubic inches, between two wine gallons

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Alveolites megastoma, Win 89
Arca modesta, Win 15
Aulopora serpuloides, Win. 91
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Avicula Whitei, Win. 8
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Aviculopecten Caroli, Win. 9. 255
~ intercostalis, Win. 95
~ Newarkensis, Win 255
~ Occidentalis, Win 9. 255.
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– concentrica, Win. 413
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Marshall – modiolaris, Win. 416
– trigonalis, Win. 15
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— ?bicarinata, W.	13.	127
— Burlingtonensis, W.		127
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— ? elliptica, Win.		13
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